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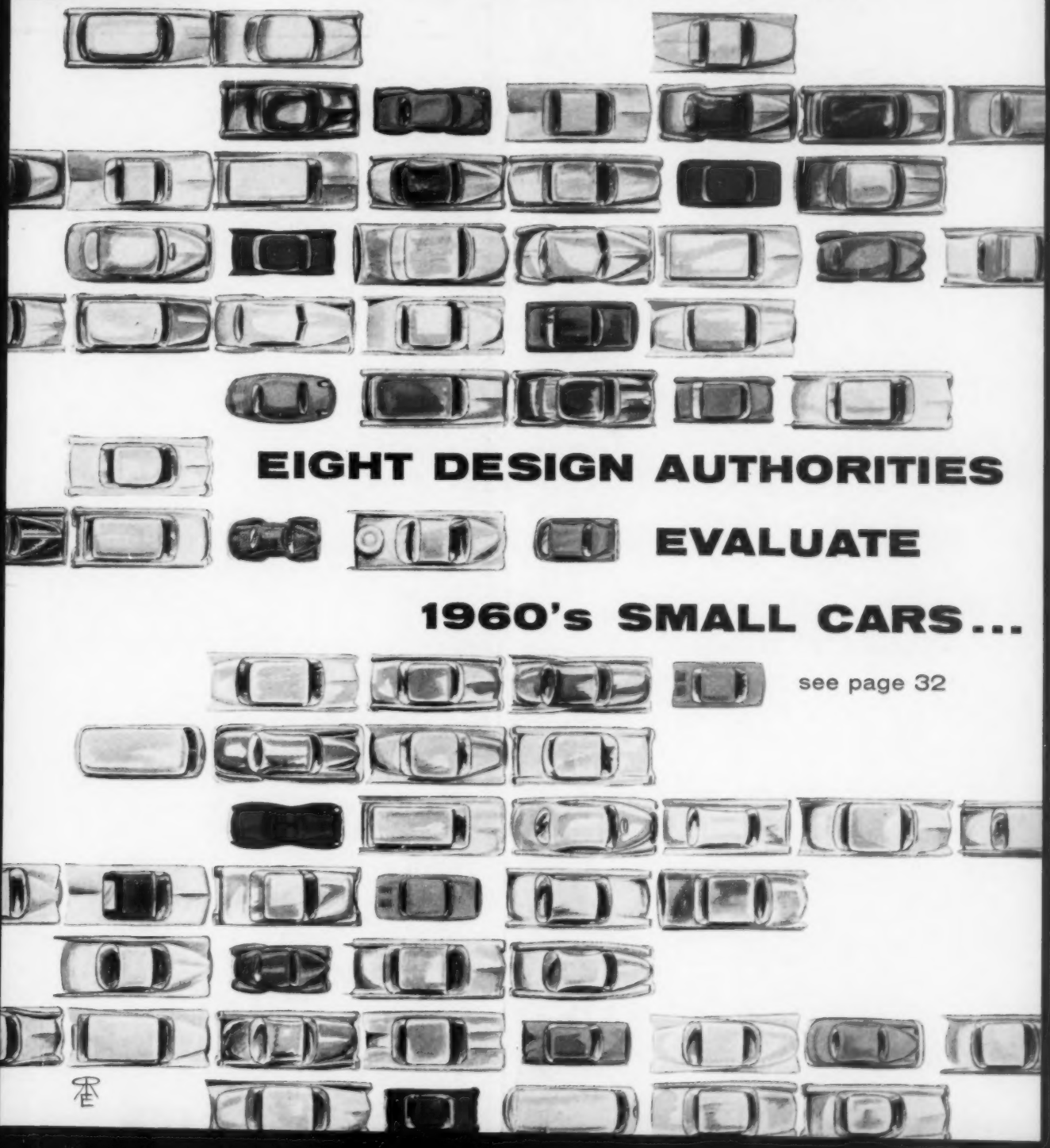

EIGHT DESIGN AUTHORITIES EVALUATE 1960's SMALL CARS...

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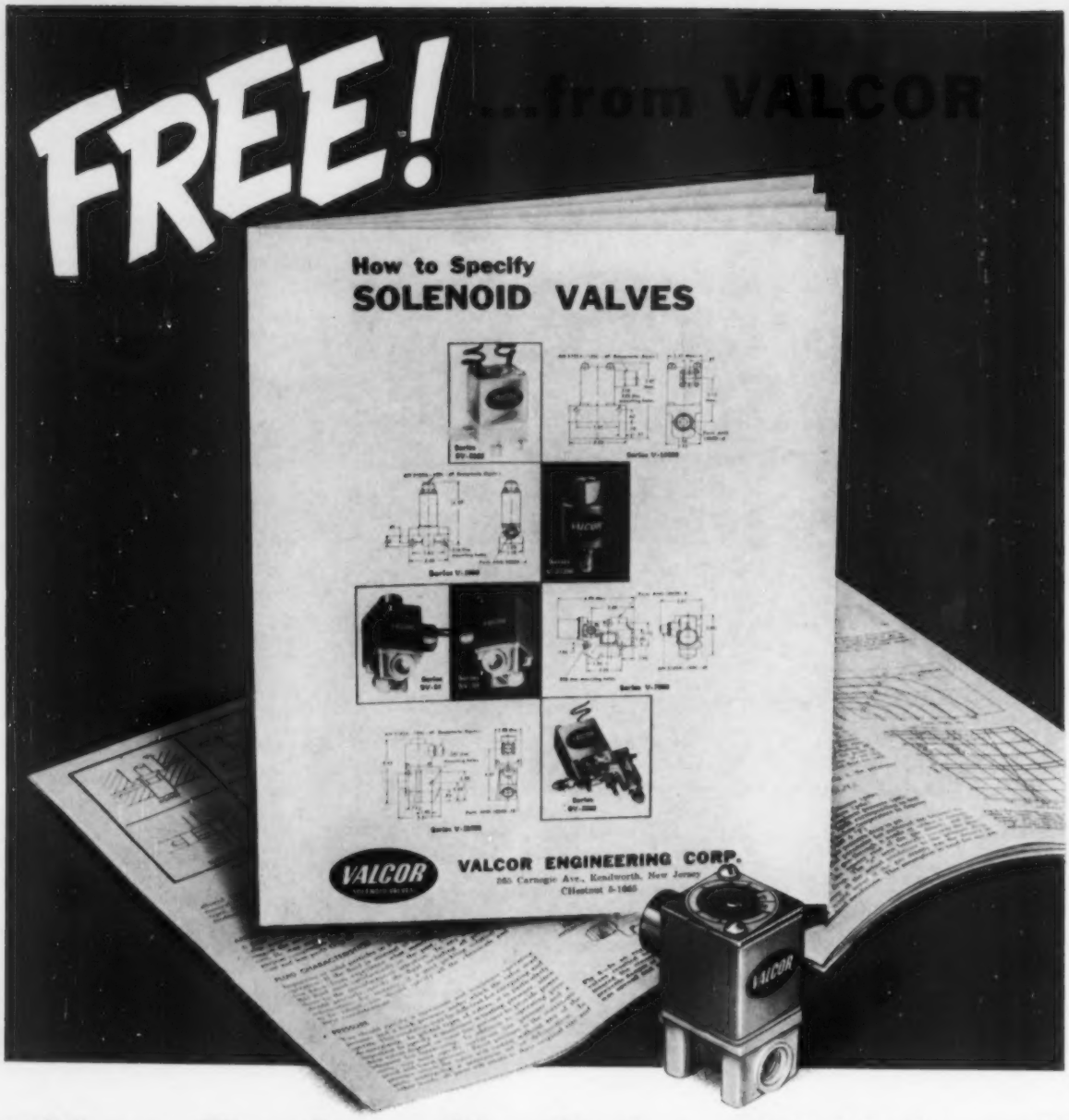

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- **How to evaluate hydraulic servovalves**
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  The 75% thread standard is now being set up and a 55% thread is under test.

- **Arcs subtended by small angles**
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Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

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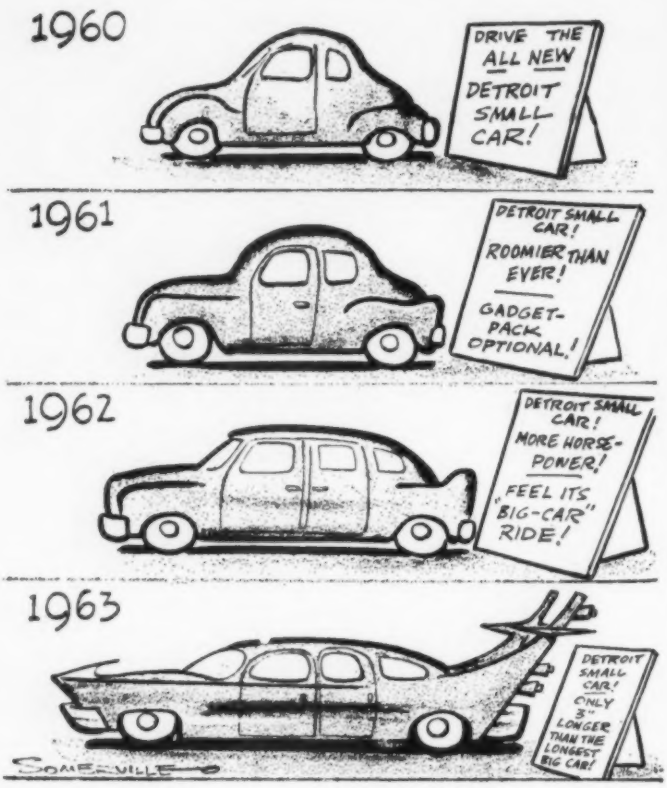
● **Our design authorities** (p 32) make no prophecies, but they seem in sympathy with this cartoon. It was taken from the Atlanta *Journal* for April 16, 1959 and reprinted with permission.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1962
DETROIT SMALL CAR! MORE HORSE-POWER! FEEL ITS "BIG-CAR" RIDE!
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November 2, 1959

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A McGRAW-HILL PUBLICATION

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- Thermal conductivity helps to dissipate heat faster, resulting in less change in resistance value before and after encapsulation.
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American

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First samples to be made available are 0.001-in. Mylar laminated to 0.0045-in. Dacron; but pilot runs of heavier gages and of sandwich-type laminates are now planned.

Dobeckmun Co developed it, calls it Dobar MD. Information and samples may be obtained from the Dobeckmun Industrial Sales Div, PO Box 6417, Cleveland 1, Ohio.

Thermocouples for 3000 to 4000 F . . .

. . . are now at the stage of practical application, says J. C. Lachman of GE's Aircraft Nuclear Propulsion Dept. GE has calibrated both rhenium-molybdenum and rhenium-tungsten couples "with sufficient accuracy to permit their use in instrumentation" and they are now in regular use. Among the applications: control of high-temperature vacuum and hydrogen furnaces (the couples must be used in inert or reducing atmospheres at temperatures above 2400 F) and operation of an argon metallurgical testing unit. Furthermore, although the materials make platinum seem cheap (rhenium wire is almost $8 a ft, platinum $5.50), these thermocouples are less expensive in use than many noble metal combinations. Too, with tungsten-rhenium alloy wire now becoming commercially available (*PE*—Oct 19, p11), it may be possible to achieve even more-efficient, less-costly combinations.

Lachman reported the GE work at the last ASME Heat Transfer Conference, is scheduled to present additional data at this week's Metallurgical Society (AIME) meeting.

High-strength vanadium alloys . . .

. . . that show good thermal conductivity, corrosion resistance and weldability, can be prepared by combining this metal with titanium and columbium, say AEC researchers K. F. Smith and R. J. Van Thyne. Furthermore, these alloys have a low coefficient of expansion and are easy to fabricate. A patent, covering ternary alloys of this type containing 2½ to 15% Ti and ½ to 10% Cb, has been issued to the AEC, and is being released for nonexclusive, royalty-free licensing. Information can be obtained from the Office of the General Counsel, AEC, Washington 25, D.C.

Reliability of mechanical components . . .

. . . is slated for much closer scrutiny in the months ahead.

At last week's National Safety Council meeting, for instance, Harold J. Cotshott of Clark Controller discussed the need for power-press air valves that would provide better than million-to-one safety in preventing press repeats (*PE*—Oct. 12, p. 35).

At the SAE Aeronautic meeting, there were discussions of design for reliability and reports on activities of SAE reliability evaluation and testing committees. There will be more reports of this type at meetings this winter, more new committees, and more new components designed not just to fail safe—but not to fail at all.

Primers for metals, easier to apply . . .

. . . and offering a high degree of clarity and solvent resistance after curing, are promised by Colton Chemical (Div of Air Reduction Co). It has developed a new water-based polyvinyl acetate emulsion which, it says, gets around the corrosion problem that has limited application of water-based coatings to metal; yet sacrifices none of the good qualities—adhesion, chemical resistance and flexibility—found in the solvent-based type.

Colton emphasizes that the emulsion, Flexbond XE-3 is still in the developmental stage. Application procedure must be refined; but it is releasing the material to formulators, and will welcome inquiries about its properties. —ARG

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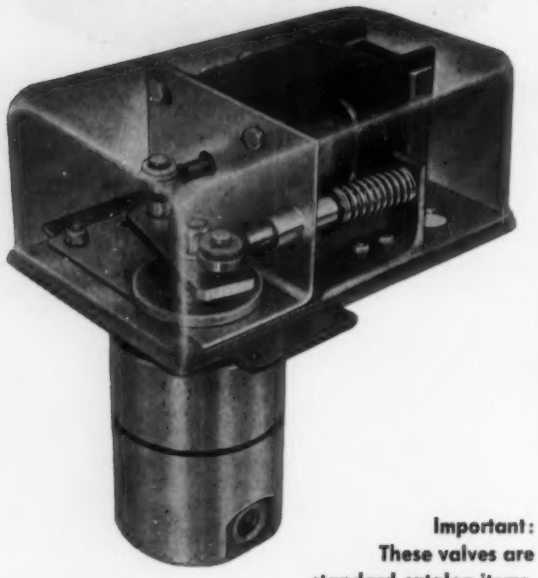

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8 CIRCLE 8 ON READER SERVICE CARD

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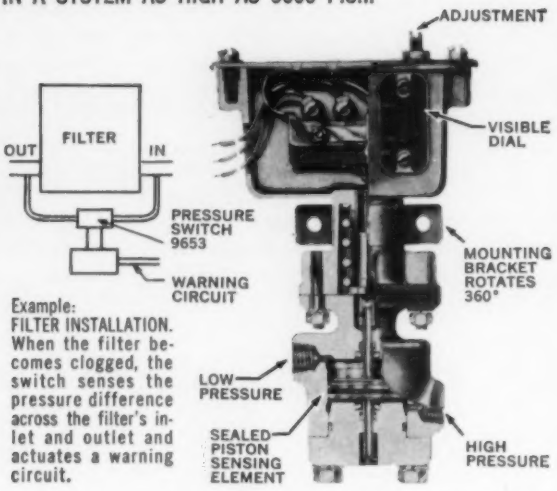

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The new Model 9653 is constructed to sense a difference from 5 P.S.I. to 140 P.S.I. between two pressures. A sealed piston sensing element actuates an electric circuit on increasing or decreasing of a predetermined pressure difference. It is applicable to oil systems ranging from 50 P.S.I. to 6000 P.S.I. working pressure. A high proof pressure rating of 9000 P.S.I. is your protection against damage from surges and shock loads. Field setting is simplified by means of an external adjustment screw and visible dial.

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PRESSURE SWITCH DIVISION

barksdale valves

5125 ALCOA AVENUE, LOS ANGELES 58, CALIFORNIA

CIRCLE 79 ON READER SERVICE CARD

DEVELOPMENTS TO WATCH...

World-wide

Porous plastic, in sheets and tubes . . .

. . . for filtration, electrolytic diaphragms, inking pads, and aeration pads, has been developed by Pritchett & Gold and EPS Co, Ltd, Essex, England.

This is a rigid ("linear") polyethylene material, pure white in color, with maximum permeability in the range of 50 cu ft of air/sq ft/min at 0.25 psi for a ⅛-in. sheet. P&G says the material is low in cost and unusually uniform.

The company is now ready to supply it in sheets 0.03 to 0.2 in thick, in sizes to 32 by 32 in. Tubes, from ⅜" up, can be made by heat-welding.

Previously available from the company is porous polyvinyl chloride, offered in 2 grades: a 5-micron type, with an air flow of ½ cu ft/sq in/min at 5 psi; and a 12-micron type, with an air flow of 3 cu ft/sq in/min at the same pressure.

New asbestos fiber, light enough in color . . .

. . . to be competitive with glass in applications where the natural gray color of asbestos previously barred its use, has been developed by Canadian Johns-Manville Co, Ltd. Aimed specifically at meeting the demand for lighter-colored, heat-resistant plastic parts, the material can be used with, or as a replacement for, glass-fiber fillers and reinforcement.

According to J-M, the treatment which gives the fiber its light color is a physical rather than a chemical one, and "does not in any way change the inherent characteristics of the chrysotile asbestos."

The new fiber is now in pilot production, is expected to be available commercially by the end of the year.

Heavy-duty spring mounting that combines . . .

. . . steel, rubber, and compressed air has been developed by Societa Pirelli-Saga, viale Abruzzi 19, Milan, Italy.

It has a steel spring inside a bellows-like rubber cylinder. The cylinder, under no load or moderate loads, is open to the atmosphere, so that the primary action is via the steel spring. The rubber cylinder, under these conditions, serves only to protect the steel and exert a limited amount of damping action, and the compressed air is not used.

Under heavy load, though, when the spring is depressed below a preset point, communication with the atmosphere is cut off, and a valve is opened, permitting compressed air to enter the cylinder. This helps the spring resist the load, and prevents the over-response that causes tilting of vehicle platforms.

For maximum resistance to corrosion . . .

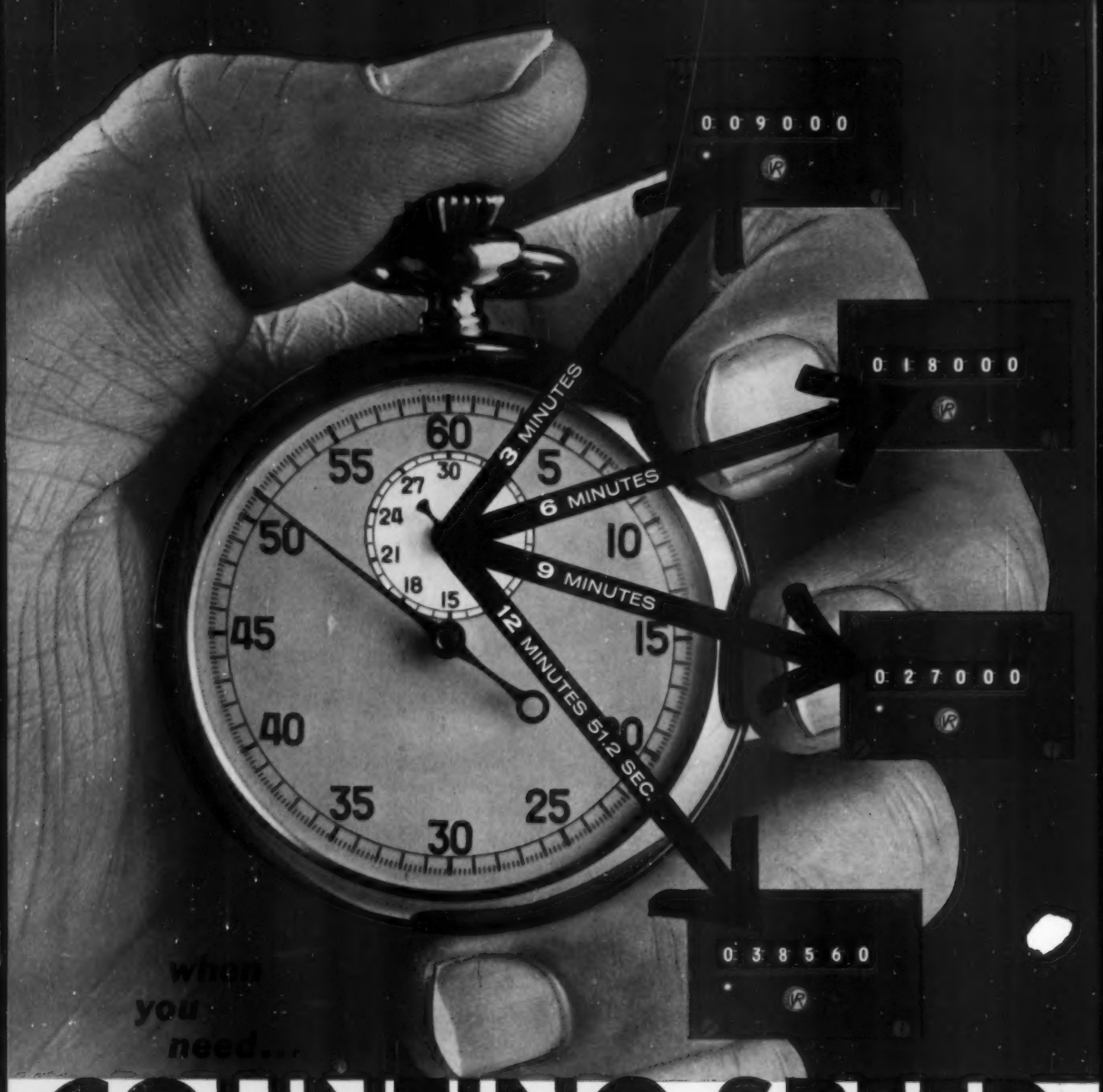
. . . of sheet-metal parts, tin coatings should be applied electrolytically and then fused in place, says a West German publication.

Reporting on studies of radio sets exposed to the extremely corrosive atmosphere of the East African Coast, B. Keysselitz says coatings applied from fluoborate solutions and fused at temperatures slightly above tin's melting point (about 45 C) gave best protection to sheet metal parts. Mineral oil was used as the fusion medium.

Low-cost rechargeable dry batteries . . .

. . . for portable radios, lighting equipment, and the like are being marketed by Oriental Electric Co in Tokyo, Japan, will soon be available in the US. Two types will be offered: One, for general-purpose use, will be priced at $4 for 2 batteries and a charger. The other, priced at $2.40 (one battery and charger) is specifically designed for transistor radios. —ARG

Japanese batteries and charging device are pictured here. These are for transistor-radio use. Built-in thermostat prevents overcharging.



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CIRCLE 10 ON READER SERVICE CARD

Billions for R & D, testing and evaluation

Military expenditures on research, development, testing and evaluation (RDT&E) of new weapons will exceed $3.5 billion in fiscal 1961 starting next July 1—at least $100-million over this year's level of spending.

That's the outlook this week as the Pentagon rushes work on next year's defense budget which goes to Congress in January.

RDT&E is the new Defense Dept designation for what used to be labeled more simply in the budget as research and development. The new designation includes a considerable amount of money appropriated directly for procurement which is spent for fabrication of prototypes and other testing and evaluation purposes.

Actually, Pentagon officials figure that an additional $1.8 billion or so in aircraft and missile procurement funds is still being earmarked for production of prototypes. As the transition to the new budget setup is accelerated, this extra sum will also show up under RDT&E rather than under procurement and production.

Measured in terms of contract awards (in contrast to expenditures) the RDT&E program for fiscal 1960, ending next June 30, will total $3.9 billion. This year's RDT&E military contracting plans have already been boosted by $170 million since May. The expenditure estimate covers shipment of prototype models, test operations, laboratory work, and other actual RDT&E effort, which, when reflected in the defense budget, lags behind the total value of new contract awards.

The outlook for next year's volume of new RDT&E contract awards is for a repeat of this year's $3.9-billion total at a minimum.

Still to be made by mid-December are decisions —on the future of the B-70 bomber, Dyna-soar orbital spacecraft, military satellite systems, and other development projects—which may have the effect of boosting the level of RDT&E contracting somewhat higher next year.

But Pentagon officials stress the Administration's intent to stabilize over-all military spending at current levels. To achieve this objective the Defense Dept is being forced to kill or stretch out major development projects. Recent cancellations of the Air Force's F-108 long-range fighter interceptor, the Navy's Seamaster seaplane, the Air Force's boron fuel and J-93-5 engine projects are notable examples of programs to feel the pinch.

How the money breaks down:

From confidential talks with Pentagon research and development experts, PRODUCT ENGINEERING offers this outlook of military RDT&E plans:

- General Sciences—new contracts will increase beyond the current $370-million total. Lumped in with this sum is all the military-supported basic research performed in physical, engineering, and biological sciences. Included are such programs as hypersonics (study of dynamics of gases at very high speeds); superaerodynamics (study of dynamics of gases at very high altitudes); research into materials with the ability to withstand high temperatures encountered in the thermal barrier region of flight; research into the nature of cosmic and electromagnetic radiation above the earth's atmosphere. One of the largest increases is planned for applied research related to anti-submarine warfare techniques.
- Aircraft—the volume of work will drop off for the first time since Korea.
- Missiles—total RDT&E costs will decrease from this year's $1.4 billion. The big question is the Nike Zeus anti-missile system which the Army wants to push into production. A decision has been postponed until next spring, but odds are heavily against a production order at this time. The outlook is for limitations of antimissile projects to the R & D stage.
- Military Astronautics—an increase over the current $309-million budget is likely as work is accelerated on navigational, communication, early-warning and reconnaissance satellites. A major decision is still pending on disposition of the Saturn project for development of a clustered rocket booster producing 1.5 million lb of thrust. The project is now being run by the Army under the supervision of the Advanced Research Projects Agency. ARPA has announced plans to transfer all military space projects to the services; control over all rocket booster projects is slated for the Air Force. There's uncertainty within the Air Force over Saturn's military utility—and its obvious drag on the Air Force budget.

There's talk of canceling the project or transferring its management to the National Aeronautics & Space Administration which recently took over from the Air Force the project to develop a single-chamber, 1.5-million-lb-thrust rocket.

RDT&E budgets for ships and small craft ($168 million), and for ordnance, combat vehicles, and related equipment ($235 million).

WHAT'S HAPPENING IN... Science

New benchmarks for the ages

First it was tree rings that provided a way to tell the age of civilizations long past. Then came radioisotopes —especially radiocarbon—as a method for establishing time lapse.

Now, G. C. Kennedy of U of California suggests still another method: thermoluminescence.

By heating a previously fired object (man-made or lava), and measuring its light glow, objects at least ½ million years old can be "dated"; and, he thinks, the technique can be extended to 2,000,000 years.

In his method, the material to be dated—igneous rock, for instance—is heated to 800 F and its light detected and measured with the aid of a photomultiplier tube. At the same time, the rock's mean radioactivity is measured. By combining the two figures, he obtains the number of years since the object was last heated. (Age of rock equals glow divided by mean radioactivity.)

Meanwhile, the standard isotope technique is moving into industrial applications—as a means for determining shelf life, for instance (*PE*—April 13, p 36); and new isotopes, among them beryllium^{10}, are being considered to extend the range from the present radiocarbon limit (about 25,000 years) to 10 million or more.

The reason why radiocarbon is serviceable only for 25,000 yr is this:

Isotope dating is based on "half life," the amount of time it takes a given amount of a given isotope to lose half its radioactivity. As the half-life of radiocarbon is about 5500 yr, and as it is not a strong emitter and its natural concentration is low, the limit of detection is reached at about 5 half-lives (25,000 yr). Beryllium^{10}, on the other hand, with a half-life of 3 million yr, should permit dating to 10 or 15 million.

There are suggestions, too, for using other isotopes for more accurate dating in the shorter range—below the radiocarbon level. Among them is radiosilicon, an isotope with a half-life of 700 yr; and, say scientists at the U of C's Scripps Institute of Oceanography, "excellent possibilities for use as a natural tracer."

Food in space: Engineers' problem

Engineers must solve space-feeding problems before long-range manned flights become possible. Space-feeding may even turn out to be a tougher problem than propulsion.

In theory, the idea of growing algae to utilize wastes and provide food sounds like a good one. In practice, it poses tremendous problems.

First of all, says the ACS *Journal of Agricultural and Food Chemistry*, who wants to live on a diet of algae for a year or two—even if it's made in the form of a hamburger and fortified with vitamins?

Second, how can the farmful of equipment required to grow algae be compressed into the size of a space ship? That's a kingsized engineering problem. Pumps, tanks, aerators, light sources and processing equipment must be designed that are not only small and light in weight, but will operate at zero gravity.

brief . . .

Basic concepts of control and safety system performance are nicely outlined and diagramed in a handsome report on "Research & Development in Reactor Safety" prepared by Holmes & Narver Inc for the AEC, and now being made available through the Government Printing Office. It discusses the problems of reactor control and briefly surveys the various systems now under test for containment and fast shut-down (magnetic clutches, rupturable diaphragms, explosive devices). The booklet is priced at 65¢.

Research throws new light on fuel performance

The old kerosene lamp, provided with new electronic circuitry, is pointing the way to improved fuel efficiency.

The lamp (see photos below) has long been standard in the petroleum industry as a means for testing smoking and rate of burning of fuels—and engineers at Esso Research say it still seems to provide the best gage of fuel performance. But it has now been reduced to its essential—wick (for rate tests) and chimney (for smoke collection)—and incorporated into the electronic instrument pictured at the left. Called a Luminometer, the new instrument is expected to replace not only the old lamp tests; but to provide information on fuel composition as well. By permitting more exact measurement of such factors as energy loss through visible radiation, it's expected to pave the way for new, less-luminous fuels that can be burned at higher temperatures. —ARG

Luminometer, now under test (left) looks far different from old kerosene lamp (right) but actually incorporates it. Esso Research engineers use the equipment to determine flame characteristics, and to develop better fuels.

WHAT'S HAPPENING IN...

Materials

Metals: Which are the most?

Two major revisions in the table of elements in the past two years (*PE*—Oct 5 '59, p 14) make the textbook listings look obsolete. There is something to be said for both old and new figures, though the old ones (*PE*—Mar 17 '58, p 66) were largely based on parts-per-million determinations on the earth. The new ones take their cue from the universe: They're based on stellar and nuclear studies and analyses of meteorites. Here are new figures on metal abundance. They're based on the element listing prepared by Dr Alastair Cameron (see reference above); but use copper as the reference point. (Cameron uses silicon-1 x 106; and on that basis, copper has a relative abundance of 212.)

Element	Relative Abundance
Lithium	47.2
Beryllium	9.45
Magnesium	4.3×10^{5}
Aluminum	4.5×10^{4}
Silicon	4.7×10^{5}
Scandium	13.2
Titanium	793
Vanadium	104
Chromium	3680
Manganese	3240
Iron	4.0×10^{4}
Cobalt	850
Nickel	1.3×10^{4}
Copper	100
Zinc	95.5
Germanium	12.0
Selenium	8.9
Zirconium	6.7
Niobium	0.38
Molybdenum	1.15
Palladium	0.319
Silver	0.123
Cadmium	0.42
Indium	0.052
Tin	0.63
Hafnium	0.053
Tantalum	0.007
Wolfram	0.049
Rhenium	0.0255
Osmium	0.302
Iridium	0.233
Platinum	0.6
Gold	0.68
Mercury	0.193
Lead	10.3
Bismuth	0.142
Thorium	0.0127
Uranium	0.0037

Sulfides: New route to high-temp materials

Almost overlooked in the hunt for refractory materials is a group of sulfide compounds with melting points above 4000 F.

These are exotic materials in more ways than one—compounds of such elements as cerium, thorium, barium, neodymium, and hafnium. Yet their unusual properties make them well worth study.

Best known of the group is cerium sulfide, with a melting point of 4300 F and a density about 6 and an electrical resistivity of 9×10^{-5}. Its oxidation resistance is not good (it needs protection above about 400 F); but, in vacuum, it's stable at least to 3600 F. Thorium sulfide, though its melting point is a little lower (just above 4000 F) is stable at even higher temperatures than cerium sulfide—almost to its melting point.

As L. M. Litz of National Carbon pointed out to the SRI High Temperature Symposium, cerium sulfide's electrical conductivity makes it possible to heat crumbles of this material by induction, and it shows a very high order of thermal shock resistance. It is also a relatively soft material. It can be fabricated by powder metallurgical methods and can also be flame-sprayed and deposited as a coating by vacuum techniques.

briefs . . .

Thin-film coating, tailor-made to transmit short-length radiation while reflecting longer heat rays, combines magnesium fluoride and silicon monoxide in a layer less than 2.5 microns thick. It was developed by Bausch & Lomb, specifically to protect solar batteries. The aim: to keep them from overheating without interfering with their absorption of the energy needed to produce electrical power. It's an interesting combination, though, that may well have other applications in temperature control.

Castor oil is a good conductor of sonic energy as well as a good electrical insulator. At Martin Co, for instance, it's used as a protective bath for sonar equipment during assembly and testing because it is not corrosive, provides a convenient air-excluding medium. (Note: For information on another promising castor oil application—in foamed urethane plastics—see *PE*—Dec 23 '57, p 9).

Another new chemical family takes the center of the stage as the Dept of Defense announces its newest fire-fighting chemical – monobromotrifluoromethane.

Brominated fluorocarbons, slower to develop than chlorinated compounds, are only now coming into their own. (*PE*—Oct 5, p 7). But they're now recognized as a promising source of new vibration-damping fluids, lubricants, and adhesives, as well as fire-extinguishing agents.

"Safe" alloys for use in explosive applications are outlined in a new Navy report, released by Office of Technical Services. This one, based on studies at NY Naval Shipyard, is more liberal in its judgments than was an earlier report from the Naval Gun Factory (*PE*—Jan 20 '58, p 18).

Manganese bronze, phosphorus bronze, commercial brass, beryllium copper and aluminum all get a good rating; while only steel and monel are labeled "unsafe."

In the earlier study, no metal got a good rating under all conditions.

Both reports are now available from OTS, Dept of Commerce, Washington 25, DC. The new study is PB151650, *Sparking Characteristics of Metals*, 18 p, 50¢. The older report is PB 131131, *Sparking Characteristics and Safety Hazards of Metallic Materials*, 36 p, $1. —ARG

Here are 6 Reasons why

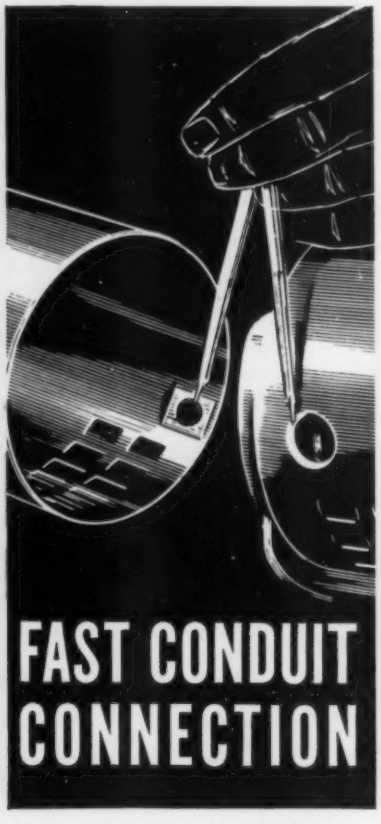
REDUCE

EASY TO HOOK UP

This enlarged wiring compartment saves hook-up time on the assembly line

Wiring compartments on G-E motors are now roomier and easier to work with. An enlarged opening allows greater accessibility. A narrower terminal board makes it easy to bring in leads from conduit. There are no extra studs on the board to result in "hook-up confusion." Easier, more accurate wiring results. How much can this extra value save you?

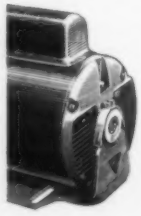
GENERAL ELECTRIC



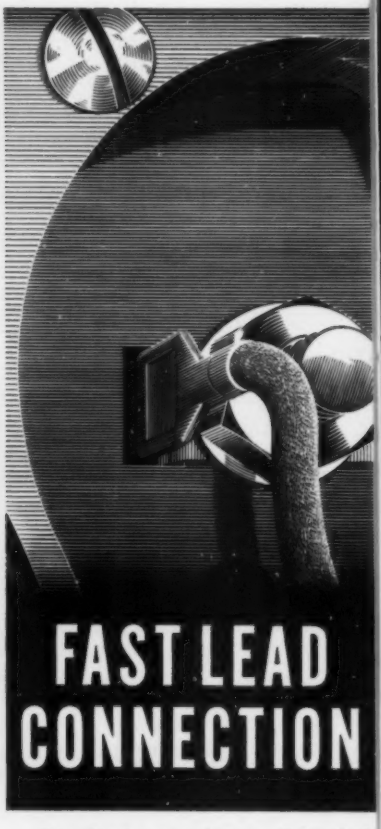
FAST CONDUIT CONNECTION

Special speed nut permits conduit connection from outside; cuts connection time 50%

Conduit connection is greatly simplified by single-thread speed nut welded inside the motor shell. This feature permits connection of conduit from outside the motor in half the time normally required with conventional lock nut. No waste of time fumbling with a loose nut, no possibility of dropping it in the motor or on the floor. It's a real time saver!



GENERAL ELECTRIC



FAST LEAD CONNECTION

Now plug-in connectors on all terminals cut wiring time in half

For the first time on all single-phase Form G motors, General Electric offers time-saving quick connectors on *all* external and internal contacts.* Wiring time is cut in half. (Studs have been retained for conventional wiring.) Simply plug in the leads. Fast, positive connections are assured. Try it yourself. You'll like this new General Electric extra value.

* Explosion-proof and a few special motors excepted.

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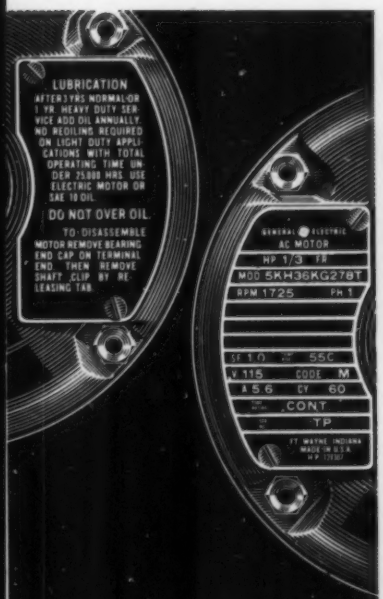
JUST ASK YOUR GENERAL ELECTRIC SALES ENGINEER

General Electric Form G motors . . .

ASSEMBLY TIME


LUBRICATION
AFTER 3 YRS NORMAL OR 1 YR HEAVY DUTY SERVICE ADD OIL ANNUALLY. NO REOILING REQUIRED ON LIGHT DUTY APPLICATIONS WITH TOTAL OPERATING TIME UNDER 75,000 HRS USE ELECTRIC MOTOR OR SAE 10 OIL.
DO NOT OVER OIL.
TO DISASSEMBLE MOTOR REMOVE BEARING END CAP ON TERMINAL END. THEN REMOVE SHAFT CLIP BY RELEASING TAB.
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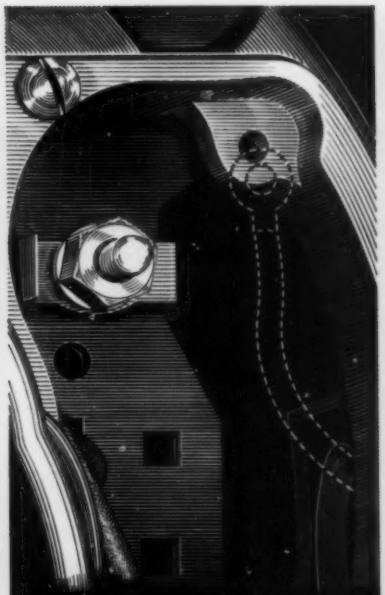
AC MOTOR
HP 1/3
MOD 5KH36KG278T
RPM 1725
Ph 1
55C
V 115
CODE M
A 5.6
CY 60
CONT
TP
FT WAYNE INDIANA
MADE IN U.S.A.

EASY-TO-READ NAMEPLATES

New permanent instructions and data simplify installation and servicing

Operating data on Form G motors is both legible and permanent to help you select, install and service without guesswork. The nameplate is engraved, then paint-filled for extra readability. Oiling instructions are lithographed on the terminal box cover plate. Lets your customers know exactly how *little* maintenance is required. *See* this extra value!

GENERAL ELECTRIC



SAFE, SIMPLE GROUND

Built-in grounding lug permits fast, easy grounding to meet UL standards

Now on Form G motors you get a built-in grounding lug that meets UL standards for grounded third lead when required. With a self-forming screw you can make ground connections quickly, easily and inexpensively. This feature assures safe, permanent grounds. There's no chance of disconnection during maintenance. Ask for details on this extra value.

GENERAL ELECTRIC

COMPACT, LIGHTWEIGHT

Small, light Form Gs easy to assemble; cut handling and shipping costs

Up to 50 per cent lighter, 40 per cent smaller than old-style designs, General Electric Form Gs are easier to handle, faster to install. Compact motor requires less mounting space and material; cuts down "assembly-line fatigue" caused by heavier motors; reduces stock space and shipping costs. You can't help but *save* with compact, lightweight Form Gs!

702-90

GENERAL ELECTRIC

ABOUT THE NEW FORM G "EXTRA VALUE" FEATURES

Extruded closed cell neoprene makes better appliance gaskets

Gasketing material of closed cell neoprene is helping solve some of the major problems in appliance sealing. Made of a non-absorbent body and thin, tough neoprene outer skin, this sealing material performs well under the most severe conditions. Manufacturers' acceptance tests show that it can take hot water, detergents, cooking oils and food chemicals without harm. This gasketing material also has excellent resistance to abrasion, ozone and natural aging. If you design or manufacture an appliance or assembly involving a compressible seal, you will want more details. Write to E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. (PE-11), Wilmington 98, Delaware.

Above—Acceptance tests on closed cell neoprene were run for 100 hours in water at 212°F., food fats and detergents at 180°F. Results showed less than 10% swell, low water absorption, no damage to sealing properties.

Upper left—Tough neoprene skin on extruded gasket resists abrasion, ozone, natural aging—won't chip, crack or peel. Closed cell neoprene retains its compressibility and sealing pressure.

Left—Closed cell neoprene gasket can be bent around sharp radii without wrinkling. Sharp corners can be cut and cemented; closed cell structure is non-absorbent.

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Better Things for Better Living . . . *through Chemistry*

SYNTHETIC RUBBER

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Product Engineering HORIZONS

November 2, 1959

what happened to "FAIL SAFE"?

Manhattan's extensive power failure last summer launched a whole series of investigations which followed the usual course—much bustle and bravura as long as there was political hay to be made. But one practical set of studies was not made—of devices in the area dependent upon an uninterrupted power supply which did not "fail safe."

There was the merchant who couldn't get into his cash register for three days because the control key was inside the cash drawer—locked there. And the other merchant who finally found the hand crank, inserted it, and found his clerks hadn't strength enough to cycle the register. There were vaults and offices that couldn't be entered because of electric protection and lack of air conditioning and lighting, elevators that stuck between floors, heating systems that permitted no auxiliary heat so processing froze.

These are all familiar accompaniments to power failure. They justify the costly auxiliary power setups in hospitals, the doubled and tripled circuitry of fire-alarm systems. But they do not justify the simple devices apparently designed with bland disregard of potential power failure.

A friend has a cruiser with a hydraulic clutch that cannot be disengaged if the engine stalls—it must be taken apart first. Many of us have cars with power brakes; when the engine dies, our brakes die with it. And we've read of the aircraft landing gear that wouldn't go down under power—or under hand cranking either.

Other similar problems—but with built-in solutions—including the double or triple paralleled systems in electronics and the "best two out of three" choices made by some computers of simultaneous solutions offered.

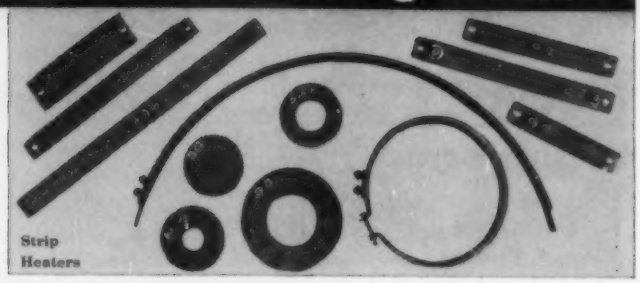
Difficulties are most often encountered with consumer products, which are designed to a price, then progressively stripped of "needless" accessories as labor and material costs rise, or competitors cut in. Obviously, the perfectly safe product does not exist, nor can all potential dangerous situations be anticipated. But the relatively normal ones should be—power failure, momentary distraction or inattention, reasonable fatigue, inexperience, childhood.

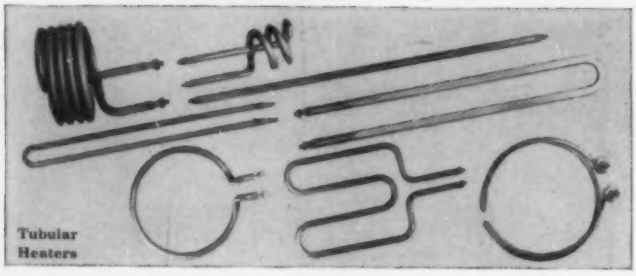
The usual outboard motor has a shear pin in the propeller to avoid shaft breakage from obstructions, a chain to prevent loss if the clamp slips, and so on. Here are "fail-safe" measures built in. But the household mixer handles fingers just as inexorably as drinks, the toaster shorts from probing forks, the iron overheats when one control fails. Still one of the greatest causes of home accidents is the power wringer.

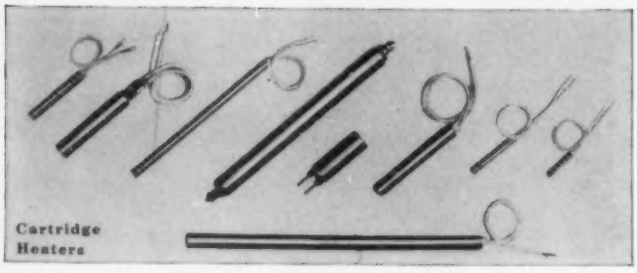
There is, of course, more to the problem than meets the eye. Consumers shy off from a product heavily guarded or full of danger signs. And they dislike warnings, instruction booklets and training courses. They feel they lose face if they don't appear to know all the answers. But in many cases they can lose more than face unless they're adequately warned or protected in spite of themselves.

To corrupt an advertising slogan, "Never overestimate the brains of the user." Make him really work to hurt or inconvenience himself.

Call your CHROMALOX Man for the heating answers







These 3 basic CHROMALOX heaters provide answers to just about any heating problem

Strip Heaters . . . that quickly and easily bolt or clamp to platens, dies, kettles, tanks, pipes, rolls, drums, ovens and air ducts. Lengths from 4 to 96 inches, widths from ¾ to 2½ inches, with cross section curving or lengthwise bending. Available with brazed-on fins.

Tubular Heaters . . . that clamp on, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts. Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Available with brazed-on fins.

Cartridge Heaters . . . that smoothly fit standard drilled holes in dies, platens, molds, extrusion and injection barrels. Special leads available for protection against flexing action, abrasion, moisture or vapors. Diameters from ⅜ to 1 19/64 inches, lengths from 1⅝ to 25⅜ inches.

Versatile Chromalox electric heaters are available in sheath materials and wattages to match almost any application to 1100°F. Easy to install, they are fast, clean, safe and economical.

Your Chromalox Man can help you determine the one that best answers your specific problem. He's backed by the world's largest factory stock of industrial heaters, ready for immediate shipment. Why not give him a call. You'll find his phone number listed at the right.

Our new Catalog 60 provides detailed product information and suggests numerous applications for the complete line of Chromalox electric heaters for industry. If you have not yet received a copy, please let us know. 1601

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THE ENGINEERING WEEK

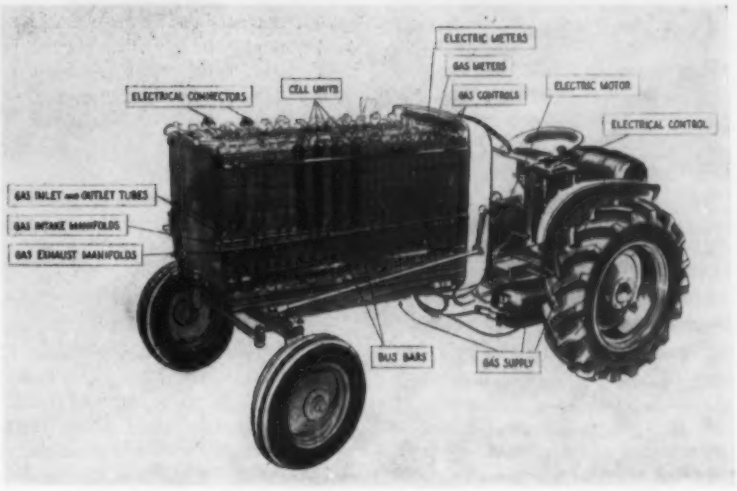
Tools Lag Behind Hard-to-Machine Metals

CLEVELAND—The trend in machine tools is to metals that are harder to machine, but tools are not keeping pace with the growing need, according to Dr. M. Eugene Merchant, director of physical research, Cincinnati Milling Machine Co. Merchant's opinion was included in his prediction of things to come during the next 10 years within the machine-tool industry. His analysis highlighted the recent AIEE Machine-tool Conference here.

Merchant predicted that maximum allowable cutting speed for metals used in airframes will be less by 1970 than it is now because of harder metals coming. Future answer might be found in other ways to remove metal by chemical milling, electro-discharge, electro-chemical, electron-beam and even plasma-jet.

Also discussed at the 3-day meeting were ways to control the machine tools in use today. The limit switch extensively criticized by engineers and plant maintenance people is said to be the cause of 50% of line breakdowns in Ford Motor's Transmission & Chassis div. An answer suggested at the conference was a new limit switch by General Equipment Mfg Co, Louisville, Ky. It has conventional contacts mounted on a steel armature. Two permanent magnets inside the switch try to pull the armature one way or the other. It will go towards one of the magnets if some metal is brought into proximity of the other magnet, thus altering the flux path.

Static-control systems are gaining recognition. General Electric presented cogent arguments for choosing a magnetic-amplifier-controlled dc-motor power package in preference to a conventional motor-generator set in the 3- to 1000-hp range. Square-D Co introduced a modular static-control system that is based on nor-logic, using transistors and diodes for most of the elements. A detailed discussion of the meeting will appear in *Product Engineering* for Nov 23. In addition, description of a design method to use nor-logic in circuit building is scheduled for a January issue. —*Frank Yeaple*



Forecast 80% Efficiency for Experimental Tractor Driven by Fuel Cells

MILWAUKEE—Fuel cells, developed in the Allis-Chalmers laboratory, have powered an experimental vehicle for the first time. Researchers here modified a D12 standard tractor (above) to take 1008 cells, each ¼ x 12 x 12 in., in four banks of 112 units, each unit composed of 9 cells. Cells convert chemical into electrical energy utilizing a propane gas mixture as fuel with oxygen or air as the oxidizer. Heat is not required. The cells operate at room temperatures. Each cell generates about one volt open-circuit, and total electrical output is 15 kw, enough to power a 20-hp standard Allis-Chalmers dc motor and exert about 3000 lb drawbar pull (PE—Oct. 26, p 36). Each unit of 9 cells weighs about 17 lb, or cells total 1904 lb of the 5270-lb machine weight, about half the weight of equivalent storage batteries.

Fuel cells are experimental designs. However, according to Dr H. K. Ihrig, director of research, they do develop about 60% efficiency. He believes efficiencies at 80% (twice that of a diesel) to be achievable.

Control in the experimental machine is through a standard street-car type controller 8 x 11 x 21 in., which places the four banks of cells in series or parallel. Reversal of polarity through a second lever changes vehicle direction. Potential applications for fuel cells, as foreseen by Allis-Chalmers, include power for home, plants and military uses, as well as for buses, tractors and lift trucks. ■

Foresee Expanded Use of Thermoelectric Materials in Homes by 1965

WASHINGTON—Applications of thermoelectric materials to functional devices seem likely beginning about 1965. At that time, industry technicians are predicting, thermoelectric heating and cooling devices will be economically competitive with conventional equipment. This was predicted as new appliances, based on a variety of research and development investigations, were paraded at a recent progress seminar in thermoelectricity staged by Whirlpool Corp.

The new devices included a compact water-purification apparatus that uses the dual-effect thermoelements simultaneously for evaporating and condensing, thus eliminating large quantities of cooling water presently required. Also displayed was a multi-compartment food cabinet for long-range-aircraft personnel. The cabinet holds frozen precooked meals until minutes before serving time when, by

reversing current flow through the thermoelements, the refrigerated compartment containing the individual meal becomes an oven and heats the meal to serving temperature.

Other devices shown were an electric current generated by otherwise wasted heat to operate a mercury pump suitable for gases and liquids a thermal junction and mercury junction, and mercury to operate gas or fluid valves.

Military representatives were attracted by a 2.3-cu ft refrigerator that operated on 72 bismuth-telurium couples drawing 25 amp and 165 watts to produce a 36F cabinet temperature.

Directly converting electricity to cold, the thermoelectric refrigerator eliminates all moving parts, compressors, motors, condensers and related components. It is noiseless, compact, relatively light in weight.

Another display item was a 14 by 48-in. radiant-heat panel that can be mounted as an integral part of ceilings or walls. It draws 15 amp and 185 watts. Whirlpool says these panels will dissipate heat or absorb it, depending on which way you throw the switch.

High material cost, plus the need for rectifying home ac, are preventing widespread marketing of thermoelectric appliances. One speaker at the seminal estimated the cost of a ¼-in. thermoelement at $2.50. The cost ratio of thermoelectric materials to conventional ones, he said, is about 8 to 1. Lifetime of thermoelements is expected to be about three years, although researchers indicate Russian scientists are claiming a 10-year life with but 3% loss in efficiency. ■

Experts Debate Printed Circuit Problems

CHICAGO—Discussions of the make or buy problem highlighted the 14th Institute of Printed Circuits meeting here. The consensus was that only large companies can afford to make printed circuits.

W. T. Jensen, executive vice-president of Methode Manufacturing Corp., Chicago, represented the "buy" group. "Vendor-made printed circuits are usually cheaper. The cost of printed circuits is small compared to the total cost of the product in which it is installed. But the cost of setting up a printed circuit production line is very large compared to the cost of machines needed to make the whole product."

C. G. Kepple, plated circuit engineering department manager of Motorola, Chicago, agreed with Jensen that it is cheaper to buy printed circuits except for large companies which can afford capital outlay for a printed circuit production line. "One important advantage gained by making printed circuits is better control over the product. We can incorporate design changes much faster than a vendor could."

Discussing circuit complexity, J. R. Sibley, president of Sibley Co., Haddam, Conn., said that in his experience "complexity usually means confused designs. Intricate circuit patterns can be worked out without becoming confused. Such confusion" he said, "usually rests from poor initial design, poor artwork, blueprints not coinciding with artwork and specification of wrong materials."

Sibley offered rules for good design: "use the printed circuit vendor as a consultant; use the vendor's experience in solving problems and let him do all artwork; don't use wishful thinking in trying to accomplish the impossible; get off to a good start in design, a poor design compounds its errors during development and production phases. Finally the designer must be familiar with production problems, available materials and their limitations."

A question-and-answer period brought warning from Stephan Gulyas, Printed Circuits, Inc, Mt. Vernon, N. Y. that if a hole is to be plated through epoxy glass laminated material, reliability requires that the holes be drilled through, not punched. Punching will separate the laminations slightly, bringing trouble later. If phenolic material is used, punching may be used safely.

R. G. Zens vice-president of Electralab Printed Electronics Corp, Natick, Mass, said in reply that "piercing dies are often built for older materials and used for modern materials such as epoxies. A piercing die must be made for use with the intended materials. Generally punching is faster than drilling, but punching equipment costs more than drilling equipment; hence better for long runs." ■

Ford Sinks $19 million in Engineer Education

WASHINGTON—The Ford Foundation has announced the first major grants in its new science and engineering education program. Grants to 10 institutions will total $19 million.

Their purpose is twofold: (1) to support promising experimental education programs, and (2) to further excellence of faculties through recruitment and development of more well-trained engineering teachers.

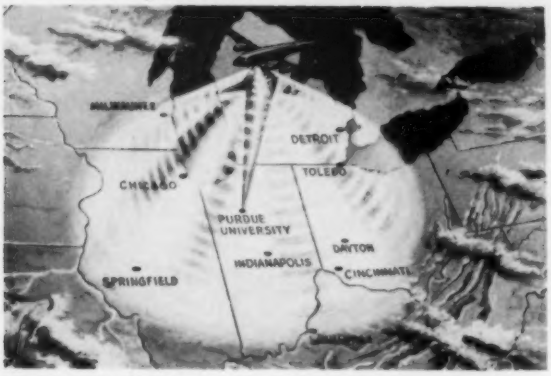
In announcing the grants, Harry T. Held, president of the Foundation, warned that engineering education—the gateway to the profession—is lagging. "In a hopeless race against time and reality," he said, "most engineering students in their late teens and early twenties are equipped for the engineering of the last half century by being indoctrinated with the art and practice of the 1950s."

Of the total, $11.2 million will go to eight schools for 15 new full professorships, to provide salaries or post-doctoral fellowships on the intermediate and junior levels and to provide funds for visiting professorships, short term residencies and pre-doctoral fellowships.

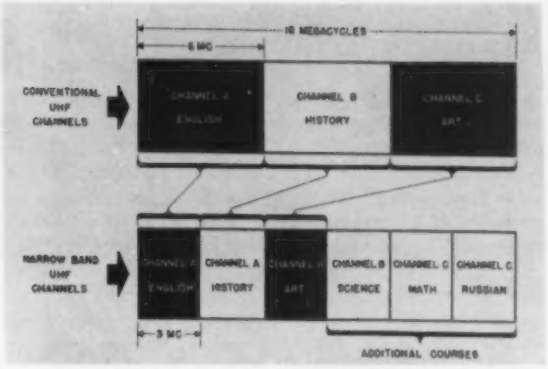
The remaining funds, to modernize curricula, will go to: MIT for developing a curriculum of science-based courses that cut across department lines; UCLA for a curriculum that concentrates on the design concept as a basic discipline in engineering education; Case for implementing the design concept through interdepartmental centers knows as the Engineering Design Lab and Systems Engineering Center; the Univ of Michigan for experiment with high-speed computers to enrich classroom instruction; and Carnegie Tech for application of basic sciences, mathematics and social sciences to engineering problems.

Recipient institutions are Massachusetts Institute of Technology ($9.3 million), California Institute of Technology ($3.2 million), Carnegie Institute of Technology ($2.3 million), Univ of California ($1.2 million), Univ of Michigan ($1.2 million), Case Institute ($1 million), Univ of Illinois and Purdue ($275 thousand each) and Stanford and Univ of Wisconsin ($200,000 each). ■

TV Teaching at 20,000-ft Altitude



Airborne educational television broadcasting system (Stratovision, developed by Westinghouse) will be applied by the Midwest Council on Airborne Television Instruction in Sept, 1960. It is expected eventually to airlift efficiency and quality of education in a six-state region, service some 5 million students in 17,000 schools and colleges. Courses will be televised from a DC-7 craft from 25,000 ft over north-central Indiana. Project will use



narrow-band transmission system operable on 3 megacycles to provide six 30-min class programs over three UHF channels, doubling the number of courses that can now be televised via wide-band system. The fact that most of the 600 schools in the US using educational television are equipped to receive only wide-band programming poses a conversion cost problem. Plane will carry four 12-kw transmitters; input power is 400 kva.

Strategic Industries Executive Charges US Usurps Patent Rights, Slows Defense

MONTEREY, CALIF — Charges that Congress is drying up the nation's "stream of technological creativity" by usurping the patent rights of private industry were leveled here by an official of the Strategic Industries Assn, an organization of more than 100 companies engaged in US defense and space programs.

Robert R. Lent, Los Angeles marketing executive, declared that only an act of Congress can spare private enterprise and stop "government erosion of the patent rights."

Speaking before a gathering of the Federal Bar Assn, Lent called upon Congress for "a formal reaffirmation of the Constitution's guarantee of the citizen's exclusive right for a limited time to the fruits of his inventions and discoveries."

Lent branded the Dept of Defense and its associated agencies as "the instigator, energetic persuader and recipient of privilege in this erosion of our liberty." He referred specifically to the AEC and the NASA.

"Defense agencies of the government hold the patent grant as merely an obstacle to their day-to-day activities, one to be avoided altogether if possible," he said.

"Usurpation of the patent grant is neither good business, equitable behavior nor within the spirit and intent of the Constitution," Lent emphasized. "It is not good business because it deliberately dissuades creative endeavor, inherently restricting the flow of technological progress and impairing our runners in the scientific race with the Russians."

The speaker claimed there is not a shred of harmony among the Atomic Energy Act, the National Aeronautics and Space Act of 1958, and Article 1, Section 8 of the Constitution, which guarantees patent rights. The two acts of Congress, he declared, "most decisively and drastically violate the intent of the Founding Fathers."

The heart of the problem, Lent explained, is this: scientific breakthroughs which today may cost their inventors and developers millions of dollars become the property of the government once they are submitted to government prime contractors for consideration. The prime contractor can duplicate a company's drawings and specifications, then submit them for bids. Under present law, Lent said, the government has full legal authority to award contracts for the production of the privately developed advancements to any manufacturer—including the inventor's competitors and even to companies not engaged in related fields of manufacture.

"Hundreds of manufacturers today simply and rigorously refuse to do business with our government," Lent pointed out. "My own company, which typifies a successful private enterprise founded on a patented idea, has not and does not intend ever to accept a government research and development contract."

Lent is marketing director for Statham Instruments, Inc, of Los Angeles, the world's largest manufacturer of transducers. These submarine instruments—the so-called eyes and ears of measurement and control systems—are used throughout industry, particularly in the nation's aircraft, missile and nuclear programs.

Private industry, faced with usurpation of patent rights has but two courses of action, Lent averred. "We must either deliberately sacrifice our brains and our talents on a horse race we know is fixed in advance, or with equal deliberation simply avoid the risk and withhold our creativity from this critical need. The first course of action is becoming increasingly sheer economic stupidity; the latter course of action is unpatriotic to the edge of figurative treason."

However, only an act of Congress will preserve private enterprise and ensure the re-enlistment of creative technology for "service on the national scientific frontier." ■

Togetherness Fails? Engineers, Management Disagree

PRINCETON, N J—Despite efforts to keep engineers and scientists happy, management has failed to reduce the conflict between itself and the technical staff. If such conflicts are not resolved, the uneasy partnership may dissolve into a sort of class warfare.

This warning, by Opinion Research Corp, is based on a survey of 622 engineers and scientists and 105 managers. Technical staff and management, the survey finds, simply do not see things the same way. They have different professional goals and are making little progress toward understanding each other's point of view.

Seriousness of the situation is emphasized by the fact that the six companies selected for the survey—one each from aircraft, chemicals, drugs, electrical equipment, petroleum and rubber—all have a heavy stake in technology. Many of the managers have a technical education. And the companies all have progressive personnel policies and practices.

But in these companies, engineers and scientists say management forces them to overspecialize, misuses their talent and underpays them. Higher salaries alone would not be a cure, the report finds, the conflict lies at a deeper level.

Engineers and scientists say that they need freedom from pressure; they need to work in their own way. Overwhelmingly, they believe that their talents are too closely channeled into work that is immediately profitable, that this undermines their creative potential. They believe managers strive for power over people and to manipulate them for their own purposes.

The manager for his part is bound by one overwhelming stricture—to run the company at a profit. Hence, he focuses on practical results. And he applies pressure to get each job done—fast.

Technical and management minds require different forms of recognition—both recognize this. The manager gains enormous satisfaction from working for a successful and profitable company. The engineer gains satisfaction from his personal contribution.

Yet little has been done within the corporate framework to provide the engineer with personal recognition—along with cash. The tendency is for each group to evaluate the accomplishments and rewards in terms of its own standards and so the successes of one may be regarded as failures by the other.

Reactor Fuel Elements Cast in Vacuum

Skull-type vacuum arc-melting furnace is used to mold uranium monocarbide reactor fuel element at Battelle Memorial Institute, Columbus, Ohio, research center where studies are being made of uranium, zirconium, niobium, chromium and tantalum. Contamination of reactive and refractory metals is held to a minimum because metals are melted in water-cooled skulls of same material. High temperatures obtainable with the high-current arc (to 6000 F and higher) permit relatively large volume melts.

Call for More Plastics Standards, Handbooks

LOS ANGELES—Increased efforts to educate engineers in the proper use of plastic materials are deemed essential to continue growth of the plastics industry, according to W. E. Zisch, vice president and general manager of Aerojet-General Div, General Tire & Rubber Co, who keynoted the first national conference of the Society of Plastic Engineers.

"We have found that very few rocket and aircraft design engineers have had training in the use of plastics. Very few schools offer courses in plastics. There are virtually no authentic, up-to-date engineering handbooks on plastics. And there is no equivalent military document to the ANC-5 for metals," he charged.

Zisch urged industry to instill in designers and engineer educators confidence in the structural and environmental performance of reinforced plastics. "We must persuade colleges to offer undergraduate courses in plastics and we must assist the armed services in every way in the production

(CONTINUED ON PAGE 24)

CIRCLE 23 ON READER SERVICE CARD

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Garlock Seals "spare" pinsetters from loss of vital oil

Garlock Klozure* Oil Seals help assure dependable operation of Brunswick-Balke-Collender automatic pinsetters by eliminating oil leakage from the gear box. At the same time, they prevent damage to the bearings by sealing out dirt and dust.

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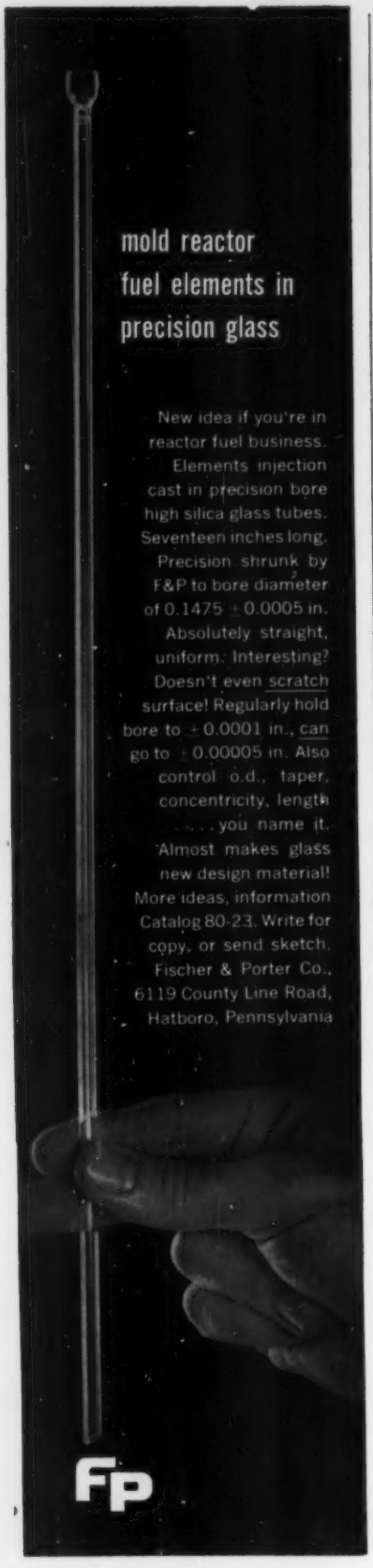
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FP

(CONTINUED FROM PAGE 22)

of handbooks on stress allowables. If necessary, the plastics industry should pool efforts to produce such a handbook," he said.

The Aerojet-General official also recommended establishment of quality-control standards, issuance of a design manual, clarification of manufacturing methods, reasonable manufacturing tolerances for various classes of materials and advice on design practice and material selection. ■

One Machine Sprays, Degreases, Coats

CHICAGO—A new metal finishing system based on Du Pont's Triclene trichlorethylene—in which degreasing, phosphate-coating and spray-in-vapor painting are accomplished in one compact machine—has been developed by Du Pont.

Compact machine which offers savings in equipment investment and floor space requires only one solvent—nonflammable trichlorethylene.

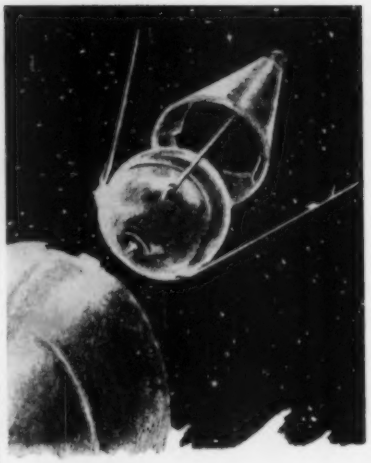
After vapor-degreasing stage, metal parts are given a phosphate coating by spraying with a trichlorethylene-based phosphatizing solution. As the parts emerge from the phosphatizing chamber, the solvent evaporates immediately. As the metal is now dry and ready for painting, drying ovens are eliminated. ■

New Diesel Features Pintle-type Nozzle

CANTON, OHIO—Designed in cooperation with Hispano-Suiza of France, a new line of high-speed multifuel diesel engines is now being produced by the Hercules Motors Corp here. The new diesels will operate efficiently on diesel fuel, Kerosene, gasoline, and JP-4 jet fuel; will not need any adjustment to switch from one fuel to another.

Design of the new line of engines features a pintle-type nozzle that admits the fuel to a precombustion chamber in the cylinder head. Nozzle is self-cleaning and is said to permit operation of these engines for over 100,000 mi without cleaning or other special maintenance. One all-aluminum V8 engine has a weight-to-horsepower ratio of 5:1.

While the engines have been designed for replacement in commercial vehicles, the Armed Forces are said to be interested in them because of their multifuel characteristic. ■



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News and Notes on...

Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

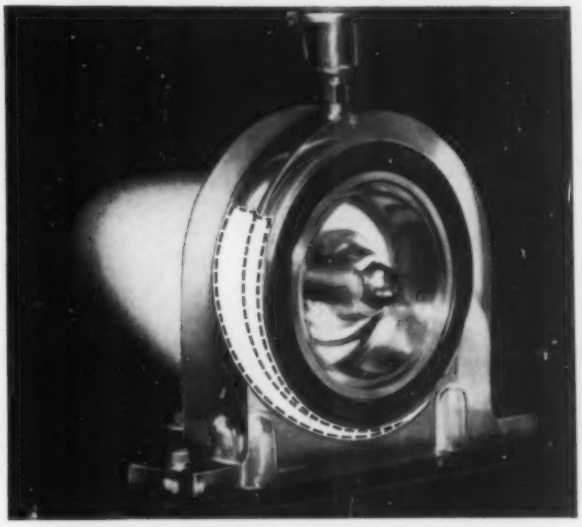
Subject of the month: Effective Shaft Sealing

Question: What is an economical way to seal in or seal out with maximum efficiency?

Whether the shaft bearing is of the sleeve, roller, or ball type . . . seals should meet two basic requirements: (1) provide a tight seal despite light applied pressure, and (2) resist abrasion and corrosion.

The transparent unit shown at the right was created by research engineers to study this subject of effective sealing . . . witness the performance of J-M seals in development stages. It helped them perfect the versatile, dependable line of J-M Clipper® Seals that serve many industries.

In this unit, Clipper Seals are mounted on a transparent cylinder, just as in a bearing cavity. The heel of the seal provides the rigidity essential for a press fit. The lip is flexible and soft so as to snug the shaft with a minimum of friction. Thus it acts like a gasket and effectively stops leakage.

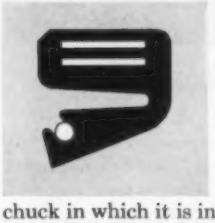


HERE ARE JOB-TESTED RECOMMENDATIONS FOR COMMON SEALING APPLICATIONS:

For General Service—Type LPD All Purpose. This line-contact Clipper Seal provides long life and maximum sealing effectiveness under a wide range of equipment variables. Its synthetic rubber base compound is recommended by J-M for most sealing lip applications where combined ambient and operating temperatures reach 250°F and higher. It seals practically all fluids . . . has proved highly effective against oils and greases, hot and cold water, air and many other gases and vapors. And it maintains its high efficiency despite time, high temperatures, and adverse conditions.

For Small Clearances—Split Clipper Seals. Split Clipper Seals have wide acceptance as temporary replacement seals for equipment with space or design limitations . . . to save costly downtime. Installation in inaccessible space is relatively simple and speedy. They are practically fracture-proof . . . stand up under the rough treatment . . . can be forced into position around the shaft. They give long-term, efficient sealing until a major overhaul permits replacement with solid seals.

For further data on Clipper Seals write for Book PK-71A. Address: Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.



For Continuous High Speed Operations—Type LPD Metal-Reinforced. This Clipper Seal, incorporating a metal reinforcement, is ideal for use in continuous high speed and extremely abusive service such as encountered in the steel industry. It expands and contracts with the chuck in which it is installed. It is a combination of two synthetic rubber base materials that are highly resistant to cracking, hardening and shrinking.

For Small Shaft Diameters—Type SS Springless. Here's the Clipper Seal designed for smaller cavities. It is made of a selected synthetic rubber base compounded to minimize swell and deterioration in corrosive applications where chlorinated solvents, lubricating oils carrying severe additives, or similar aggressive fluids must be sealed. It is a complete part in itself—contains no metal spring. No spring is required because this seal is designed to exert sufficient lip interference on the shaft to compensate for wear over a long period of time.

JOHNS-MANVILLE

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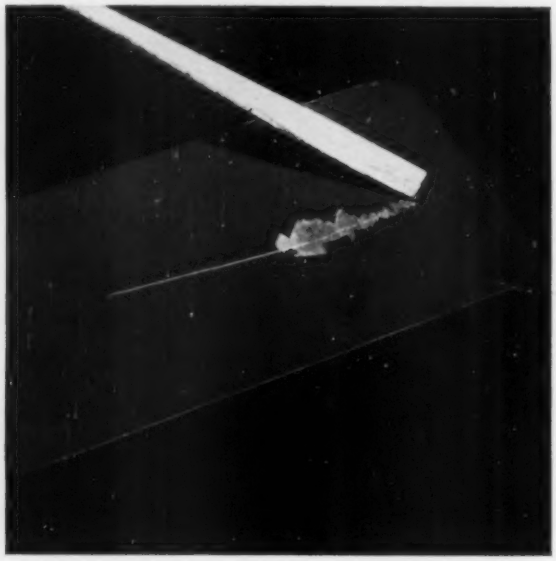
Produced by a special Armco-developed hot-dip process, the zinc coating on ZINCGRIP Steel won't flake or peel even in severe drawing operations. In the test shown above, the metal was formed until it ruptured, despite severe stretching, the special zinc coating didn't flake, even at the fracture.

The uniform, tightly-adherent zinc coating on Armco ZINCGRIP Steel assures over-all protection against rust and speeds production. You can also add extra sales value to your products, often at less cost.



Armco ZINCGRIP PAINTGRIP® Steel

ZINCGRIP PAINTGRIP Steel has the same special zinc coating as Armco ZINCGRIP Steel plus a mill-applied surface treatment that holds and preserves paint. The gouging screwdriver illustrates how paint clings to the treated surface, flakes from the untreated section. The uniformly treated surface of ZINCGRIP PAINTGRIP can be painted without additional treatment and simplifies painting. For parts that require the protection of a zinc coating and must be painted for appearance, Armco ZINCGRIP PAINTGRIP boosts performance and cuts cost.

For your products that require low cost but durable protection against heat, corrosion, or a combination of both, consider the multiple advantages offered by these four Armco Coated Steels. They enable you to match desired performance against service requirements at least cost. For more information on these special Armco Steels, just fill out and mail the coupon.

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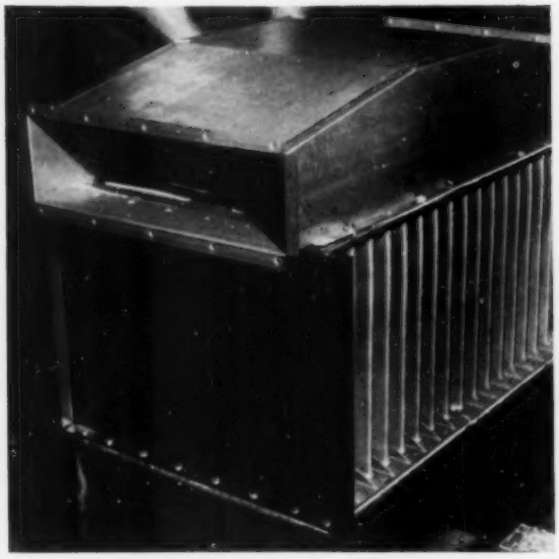

Armco ALUMINIZED STEEL Type 1

This unit for a gas-fired space heater is made of Armco ALUMINIZED STEEL Type 1. It is one of many applications that include auto mufflers, drying ovens and appliance parts where this special hot-dip aluminum-coated steel has become the "standard" material. Combining the surface characteristics of aluminum with the strength of steel, ALUMINIZED STEEL has excellent resistance to a combination of heat and corrosion, high heat reflectivity, and good fabricating characteristics. You gain advantages offered by no other metal in its price class.

Armco ALUMINIZED STEEL Type 2

This grade of hot-dip aluminum-coated sheet steel assures low cost, lasting resistance to atmospheric corrosion. Service in many types of applications and outdoor corrosion tests demonstrate that the coating on ALUMINIZED STEEL Type 2 outlasts the coating on unpainted galvanized sheets by at least 3 to 1 in an industrial atmosphere. The combination of durability and strength make ALUMINIZED STEEL ideal for structural applications and products exposed to the atmosphere. It assures dependable, long-time performance at minimum cost.

ARMCO STEEL

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ENGINEER RECRUITMENT . . .
caution and prudence on both sides

Fewer than one engineer in ten will change jobs next year. He'll change for a better working atmosphere, a more challenging assignment—he'll probably not be offered much more money.

Recent reports of widespread pirating, auction-block bidding and luxurious entertainment are wildly exaggerated according to this Product Engineering survey.

DORA MERRIS
assistant editor

Companies are expanding, and top engineers are very hard to find, but by-and-large, ethical practices are the rule, and the old days of wine, women and song are past. Recruitment advertising emphasizes technical opportunity, not salary or the idyllic life. Today's engineer is after opportunity, growth potential, occasionally a private office and title; if he's sold a bill of goods, he'll move on.

The job opportunists are a chastened bunch. The fellow who spirals from job to job into higher income brackets is much less common now than before the recession—too many got caught between jobs. For the industrial recruiter, this means that turnover is a less vexing problem—unless, of course, he's trying to staff for expansion.

Recruiting has not diminished. On the contrary, most firms are actively seeking engineers for defense and commercial expansion. But the engineer is changing jobs more prudently. The companies are more discriminating.

Not the Roving Kind

John Doolittle, employment supervisor of Ampex Corp, Redwood, Calif, sets the general tone for industry when he says "finding engineers is the main problem. Once they are hired, they stay on the job. We have under 2% annual turnover of our entire personnel, and turnover of engineering personnel is lower than that."

At Food Machinery & Chemical, turnover is running about 3% a year. The company employs about 1500 engineers—chemical, mechanical, electrical and industrial. This year, FMC will hire at least 100 engineers, probably 125. This increase, the company says, is not because of turnover but because of increased production and new design activity.

Texas Instruments says turnover is infinitesimal — though it may run as high as one in 10 among new engineers. Republic Aviation on Long Island says that the company occasionally loses a good man but the big problem now is finding experienced men to staff the new lab.

J. R. Dekker, western representative of the Engineering Societies Personnel Service, estimates that 10% of all engineers change jobs each year. In the eleven-state area he serves, there are about 150,000 engineers, and about 15,000 of them shift jobs each year—about 1500 use employment agencies. A survey of 387 companies by the Engineers Joint Council shows that turnover in industry in 1957 for all reasons was 11%. Last year it was about 9%.

Companies offer a variety of explanations for the lower turnover. For one thing, engineers have learned that there is no perfect job. And companies are making a special effort to hire engineers likely to stay—and go out of their way to keep them.

One Cleveland manufacturer of printing equipment says it makes a conscious effort to keep its engineers content. Salary is only one means. The company gives its engineers an enclosure or private office quickly. When it air-conditioned one of the plants, the engineering section was first.

A growing company is also an attraction. One reason engineers stay on the job, according to John Doolittle of Ampex, is that there are many individual success stories in the company. Two years ago there were 2000 employes, now there are 4000—of which 400 are engineers. In this two-year period many became project leaders, others section managers, still others unit managers.

On the other hand a source at Lockheed Missile and Space Div says that turnover, about 8% a year, may be higher this year. The division has reached its peak, he says, and the company cannot offer expansion as an inducement to keep engineers.

Variety of work and mobility within the company are

other inducements. Food Machinery & Chemical attributes low turnover in part to the variety of projects available. The company produces bags for containers, boxes, packaging machinery, food-process equipment, petroleum-production equipment, pump and water-treatment and waste-disposal equipment among others. Texas Instrument says that periodic job reviews to help an engineer broaden his experience and transfer out of a highly specialized job that may get boring are important factors.

Fringe benefits are a factor. Varian Associates allows engineers to participate in stock ownership and profit sharing benefits. Temco Aircraft Corp attributes low turnover—4% annually—to pension, profit-sharing plans, employment in new facilities.

Engineers take root in a section of the country and are immune to the promises of a bright future elsewhere. This is particularly true in the South. One Southern company, that hires anywhere from 150 to 400 engineers a year, says turnover is below industry's average. Engineers are absorbed in the community life and establish strong ties. Another company in the same area with an engineering force of about 300 loses only 10 men a year. Varo Manufacturing company of Garland, Texas, concentrates on recruits from the Southwest. Those from the East and West coast won't stay. "And," says the recruitment officer, "Southwesterners are better and harder workers."

A more realistic approach to interviewing is cited. At Lenkurt Electric Co, according to Jack Shannahan, employment manager, the applicant tours the plant and potential work area. He is encouraged to talk informally with other engineers—over lunch if possible—and without the boss present. "We want people to speak candidly," he explains. "After all, if we sell him a bill of goods, he'll leave within six months anyway."

Where economic factors are the lure, particularly on executive levels, the bait must be good. A source at F. C. Brown, a New York management consultant, primarily concerned with placing technical executives in electronic firms, finds prospects very selective. Stock options in a growing company or substantial income increases are the main appeals.

Just the Facts, Please

Recruiting procedures are not changing significantly —but the approach of the recruiter is changing as a result of engineers' intense job interest. Companies continue to use newspaper advertising, recruiting teams in major cities, suites at professional and trade shows, employment agencies, college visits and word of mouth. Firms in the East seem to find newspaper advertising, particularly in the New York *Times*, especially effective.

Often a company can't say just how many engineers an ad produces, but persistent advertising keeps the company in mind and creates an image of the type of work it does. When an engineer is ready to make a change, that company will come to mind.

Advertising columns reflect the engineer's interest in job content. A few years ago, according to Deutsch & Shea, Inc, a New York advertising firm specializing in ads to engineers, jobs were advertised in vague glowing terms. Now the ads give facts about specific projects—a more effective approach to fact-conscious engineers. Engineers—and their decision-sharing wives—are also interested in community facilities—particularly schools; ads now describe such facilities. Some companies publish brochures describing what the area has to offer.

Deutsch & Shea, as part of its research activities, has run five motivation surveys among engineers, to help their clients get and retain good men. In four they found that engineers were primarily interested in interesting work or a job with opportunity and secondarily in salary. On one survey, salary was listed as most important.

As part of recruiting, some companies encourage their engineers to write articles for professional journals. Such journals are read by the kind of man the company wants to hire, and may influence him to switch jobs for the professional associations.

Co-op Loyalty

Some companies are attempting to solve the recruiting problem by getting the young man early. This is particularly true in the South and Midwest. The time is coming, says one Chicago area recruiter, when recruiting will have to start when youngsters first enter college. His company will do most of its recruiting through co-operative programs at Midwest colleges this year. By the time a student has spent a year and a half at his company, he explains, both student and company know whether they like each other. Such recruits are likely to stay.

Hiring co-op students is the "ideal solution" says the head of a Southern industrial relations department. His company hires 25 to 30 engineers a year—about 75% from the co-op programs. The company can't compete with glamor industries in salary, but these students, he says, find company policies and opportunities outweigh better offers from elsewhere.

The Price of Recruitment

The cost of all this recruiting varies widely—depending on how scarce the talent. One company spent $20,000 advertising for a man with special experience—and never got him. The cost of finding a civil or chemical engineer may run as low as $200 to $300. Companies reporting to PRODUCT ENGINEERING reported costs averaging between $1000 and $1500.

Are these recruiting costs too high? Ken Barry of the Business Men's Clearing House, a Dallas employment agency, says yes, and that money wasted on recruiting is often the fault of incompetent personnel departments. Too frequently, personnel people do not know what engineering management is looking for and pass up qualified engineers.

A stronger statement is made by Eugene Shea, vice-president of Cadillac Associates — a Chicago employment agency. He says that the annual recruiting bill could

"YOUR NEXT POLYESTER COMPONENT: mold it or machine it?"

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Giving the designer facts to help make the *right* design decision faster is perhaps our best "product." Offering the broadest line of plastic materials and services permits us to give impartial help. Take polyester glass mat.

If the facts about configuration, volume, performance, operating conditions and cost point to a *molded* polyester shape, we'll work from scratch—or from your drawings—and deliver 100% usable parts.

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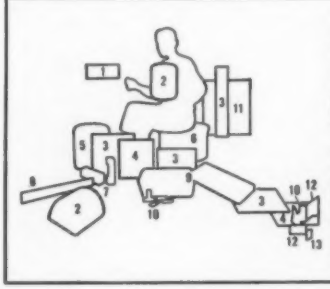
One more point. The problems inherent in machining polyester glass laminates have had a tendency to discourage some designers from considering it. We suggest that you bounce this headache out of your production facilities and into ours.

You see, we are interested in *both* your design and machining problems. Your component will be skillfully machined at one of our four complete, "service-located" fabricating facilities.

Send for our Polyester Technical Bulletin 1164. We'll be happy to include, also, data on the full line of National materials—over 100 grades. Write to National Vulcanized Fibre Co., Dept. H-11 Wilmington 99, Delaware.



1. Silk screened sign, polyester sheet. **2.** Molded weldor's helmets. **3.** Polyester sheet, natural. **4.** Polyester sheet, black. **5.** Molded radome cover for traffic radar detector. **6.** Molded explosive powder bucket. **7.** Molded photographic film splicer housing. **8.** Machined circuit breaker support bar. **9** Molded tray & lid. **10.** Punched terminal boards. **11.** Molded bread tray. **12.** Punched electric arc suppressor. **13.** Machined cam block.

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CIRCLE 31 ON READER SERVICE CARD

be cut in half if 100 of the largest companies would modernize methods. He especially deplores mass-production form letters and applications. Form letters are distasteful to half the men approached—and this is the half with the greatest talent. Successive interviews with the men who respond, are fruitless, because the company never sees the really good men. Companies lose good prospects, too, because a top engineer doesn't want to talk with the personnel department. He wants to see the men he will work with.

One of the greatest operational problems, says Robert Moore, vice-president of Richardson, Bellows & Henry, a New York firm of management consultants, is that those responsible for recruiting do not know how many men they really need. A department head says he needs four men when he really needs two—hoping he will get first option on the few who appear. Too many companies lose good prospects, he adds, because they fail to keep appointments. A prospect's ardor cools if he spends hours waiting around for the people who are supposed to interview him.

Weighing the Ethics

On the whole, recruiting, though intensively competitive, is considerably more respectable than it was a few years ago. The line between fair competition and questionable practices is more clearly drawn—especially in college recruiting—through the efforts of professional societies and the College Placement Council.

The charge of piracy is less frequently made, though it is still heard. (When someone gets a man from you, it's piracy. When you get a man from someone else, it's honest American competition.) One Chicago firm says piracy is its biggest problem. In this case, the firm offers a prospective engineer a reasonable salary, but loses him because another company offers him something better. The company will solve the problem by getting co-op students early. At least one West Coast aircraft company says it will not hire engineers who are employed by other aircraft firms.

Many companies today rely heavily on word-of-mouth recruiting, and it's an accepted practice. (One Chicago company pays a $500 bonus to any engineer who gets another engineer to join the firm.) But when a company urges employes to ferret out engineers at some other company in an organized way, the cry of unethical tactics is likely to arise. One manufacturer who recently lost a man by mutual consent reports that the engineer took another job and then, at the behest of his new employer, approached his former associates with offers of high salaries and glowing tales of working conditions in the new firm. Only one man left, the manufacturer reports, but the staff was badly upset for some time.

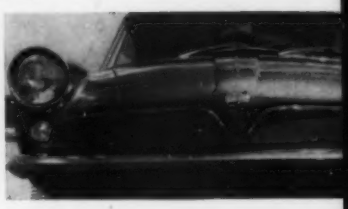
Recruiting at professional meetings is more subdued than it was a few years ago. Many societies—the ASME for one—prohibit recruiting in hotels where meetings are being held. Of course, no one can stop a recruiter from tapping an engineer on the shoulder, but efforts are being made to emphasize the professional aspects of meetings rather than their job-market appeal.

In college recruiting the College Placement Council of Bethlehem, Pa. has had considerable impact in drawing up ground rules to guide activities of college recruiting. In 1957 when the engineer talent search hit peak, the Council drew up a statement of Principles and Practices of College Recruiting. Neither the Council nor colleges use authority to enforce the rules. (A college recruitment office can schedule a company at the end of a season after the good candidates are gone if a company behaves improperly.) But punitive measures are not needed, says Robert Herrick, Council director. Under the rules, industry recruiters are asked to provide factual literature about the employing organization, and are enjoined from offering gifts, bonuses, or the aid of a third party to influence students. They are expected to accept student job refusal as final. For his part, the student is expected to honor employment commitments, and forego additional job interviews once he has accepted a position.

Such restraint is good, a Cleveland recruiter says. Industry realized two or three years ago that the wining, dining, plush-carpet treatment did the industry no good. Dignity and prudence are now the watchwords, and everyone will benefit. ■

EIGHT DESIGN AUTHORITIES *evalua*

JAY DOBLIN • director, institute of design, illinois institute of technology
MARTIN L. FRIEDMAN • curator, walker art center, minneapolis
R. BUCKMINSTER FULLER • architect-engineer, new york
HARRY GREENE • industrial designer, pasadena, calif
J. McLEOD LITTLE • industrial designer. maumee, ohio
KARL LUDVIGSEN • editor, sports car illustrated, new york
FRANK N. PIASECKI • aeronautical engineer, morton, penna
T. H. ROBSJOHN GIBBINGS • furniture designer, new york



■ If imitation is the sincerest form of flattery, European automobile makers must be flattered by the current revolution in the American auto industry. The "big three" American compact cars mark the first important design change out of Detroit in decades. How does the appearance of these compacts compare with the Lark and Rambler that first broke from the traditional big-car look? How do they compare with their small and compact European sisters, with whom they will have to compete in the marketplace?

Most of our panelists were pleased with the small car trend. For example, Karl Ludvigsen thought that, "without a doubt the new American compacts have a refreshing individuality which is far more than skin deep." But R. Buckminster Fuller expressed sadness, "America was granted a brand new opportunity, in the compact cars, to re-establish in auto design the integrity imposed by the economy of nature. The re-imposition of all of yesterday's mistakes may prove suicidal."

Some of the big sellers and popular favorites (such as the Volkswagon, Dauphine, "American" Rambler) are missing; as much as possible we had to limit the panel to those cars that have undergone major restyling for 1960.

A summary of our panelists' replies to our questions follow with comments, based on photos of the individual makes.

1) It is probably safe to assume that a small or compact car is intended primarily for transportation, with minimum attempts to impress with size, decoration and other such devices. How well do you think these cars reflect this concept?

Several panel members argue that functionalism played little part in the auto companies' decision to market compact cars. According to Karl Ludvigsen, "With the exception of the BMC Austin and Morris, no company represented here has yet dared to place all emphasis on sheer utility." Says Robsjohn-Gibbings, "It might be snobbery in reverse—keeping smaller with the Joneses!" Doblin looks at the compact American cars, "as a na-

PRINZ

DOBLIN: No phony grilles, wrinkles or details — good job.

FRIEDMAN: Bumper designed to bump rather than to menace or impale.

GREENE: The foreign import that impresses me most.

LUDVIGSEN: Approaches the beautiful as only the Italians can with regularity.

TRIUMPH

DOBLIN: Worst of American design appliqued to awkward form. When the British are good, they are very good but when they are bad, they are horrid.

FRIEDMAN: Too many ideas in conflict.

GREENE: Color separation and paint job do a great deal to detract from basic lines of car, which may be better than it looks.

DKW Jr.

DOBLIN: Too bad an essentially good concept must suffer at the hands of detail.

GREENE: Relationship of very small wheels to rather chunky body is unfortunate.

LITTLE: Conveys idea of well-thought-out car for this field.

CORVAIR

GREENE: Looks surprisingly good. However, horizontal belt line which protrudes all the way around the car separates top from wheel and working area. Too bad the fact that this is a rear engine car is not dramatized.

FULLER: Looks best going backwards.

LITTLE: Long overdue and refreshing change which is still reminiscent of old flavors. Why a visor over rear window and none over windshield?

LUDVIGSEN: Already a classic of its kind.

VALIANT

DOBLIN: Too much sculpture frippery for a compact car.

LITTLE: An effort to be something it isn't. A child is not a small adult.

PIASECKI: Trunk edge low enough to make for easy loading.

FIAT 1800

DOBLIN: Too much design, a shame after so many good things from Fiat.

FULLER: A miniature '56 Lincoln with aircraft carrier styling.

PIASECKI: Ultimate in sharp, thin-line styling technique.

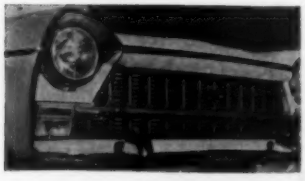
960's *small cars*

CORVAIR

NSU PRINZ

VALIANT

RIUMPH HERALD



DKW Jr.

FIAT 1800

FALCON

LLOYD ARABELLA

AUSTIN MINIMINOR

ANGLIA

LAR

BMW 70

RAMBLER

tural result of the former 'big 3' having become the middle-priced three."

2) What indications do you see of American influence on the European cars included here? How about European influence on the American makes?

Everybody tends to agree with Greene that "the influences of Europeans on Americans—and vice versa—has now become a pretty general merry-go-round." The European influence upon American compact cars is best summed up by Little: "restraint, clean tailoring, simplification with monotony." Fuller: "American effect on European cars is toward nonsense and resource-wasted symbolism." Robsjohn-Gibbings: "Vulgarity is catching."

3) Do you think these small and compact cars constitute a forward or backward step in the evolution of auto design?

Here the panel is split. Messrs Green, Friedman, Ludvigsen, Piasecki, Little and Doblin agree guardedly that some progress has been made. Robsjohn-Gibbings refutes: "The small car is still only the equivalent of aboriginal head shrinking; there will not be a good small car until it is conceived of as an entirely new automobile entity." Fuller comments that ". . . obvious excess poundage and geometry [applied solely] for styling purposes, increases both kinetic and spatial vulnerabilities, making them inherently susceptible of expensive repairs." According to Ludvigsen, "All these cars (excepting the Fiat 1800—a large, luxury car by Italian standards), reflect a world-wide trend to smaller displacements and overall sizes in search of utility and economy. A step forward has been made in the sense that most of these cars use styling as it should be used—as a true expression of the purpose of each car."

4) Many authorities complain that there have been too many "look-alikes" among recent American autos. Do you think these new compact models tend to reverse or strengthen this tendency?

The three industrial designers (Greene, Doblin and Little) agree with Ludvigsen that the American compacts tend to break away from the "look-alike" trend. Greene and Little believe that the greatest number of "look-alikes" will be among the imports in 1960. In disagreement, Robsjohn-Gibbings says, "American automobiles have always looked like a flock of sheep. Small cars are a flock of lambs. The mindless conformity of the large automobile is repeated in the smaller car."

5) Which car do you like the most? Which the least?

We might well have asked, "Who's the prettiest girl in the world?" Of those who voted, the tally is: Best liked—Falcon (2 votes); Prinz, Corvair, Miniminor, (1 vote each). Least liked—Triumph, Lark, Rambler, Corvair, Miniminor and Fiat (all with one vote.)

6) What improvements in design would you suggest for the '61 models?

Friedman: "Get rid of notions about multipurpose of car."

Piasecki: "Compress dimensions horizontally and get more car on the road."

Little: "Only slightly curved windshields. People in rear seats to ride backwards.

Ludvigsen: "Additional recognition of the important role of aerodynamics in the performance and economy of low-powered vehicles. More emphasis on braking and emphasis on 'primary safety' (keep the accident from happening)."

Robsjohn-Gibbins: "I would purchase a Rolls Royce, install it in the design studio and ask that the same nobility, respect for human dignity and design longevity be captured in a small car." ■

FALCON

LITTLE: Low body effectively suggests weight and low center of gravity.

LUDVIGSEN: . . . basic soapcake shape. Styling so ascetically simple that even door and trunk locks stand out as major details demanding better attention.

DOBLIN: Neat, but obviously a styling job . . . too much irrelevant sculpture.

GREENE: Embossed side treatment is weakest part of car. Overall, the best design and should wear fairly well.

ANGLIA

DOBLIN: Basic size and proportions okay, but details spoil an otherwise good form.

LUDVIGSEN: Faces the world with an aggressive pout. Grille is applied like a decalcomania without a clear indication of its air-scooping function.

ROBSJOHN-GIBBINGS: Is it cricket to steal American fins?

RAMBLER

DOBLIN: Integrity of design is being diluted.

GREENE: Looks better this year with Buick's rear end than it did last year with its own.

LUDVIGSEN: Successful formula only improved for 1960.

ROBSJOHN-GIBBINGS: Fins at rear inexcusable.

ARABELLA

LUDVIGSEN: Cleanest part is grille and front end contrasting with rounded pseudo-American lines of the rest.

PIASECKI: A small car trying to look like a big one but retaining nimble look.

GREENE: Good example of the dominating American and Italian cliches.

MINIMINOR

GREENE: It is direct and functional, encloses the space needing to be enclosed. However, there is no organization or emphasis which could give real direction or make it exciting as a moving vehicle.

FRIEDMAN: A small car with no ambitions to be a big one.

ROBSJOHN-GIBBINGS: How can the nation that created the radiator on the Rolls-Royce do this?

LARK

DOBLIN: Poor old Studebaker trailing along again with cast-offs.

FRIEDMAN: Chrome strip line searching for a function.

LITTLE: Credit should be given that it is not a 'gorped-up' version of last year.

PIASECKI: Best bumpers of all.

BMW

GREENE: Excellent relationship of form between front and rear decks.

LITTLE: About as clean a design as has yet been seen.

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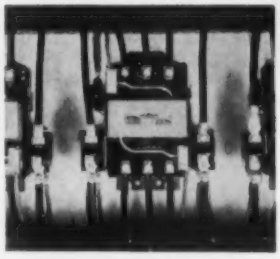

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at 1750 rpm speed. Interlocking, spring-loaded, nylon vanes rotating against inclined face of marine bronze pump body, are forced in and out of slots located at 90° intervals in self-lubricating nylon rotor. Cover and shaft are stainless steel. Pump is self-priming, reversible and is said to be free-running wet or dry. Design provides self-adjusting take-up to compensate for wear. Will be available later in 5 gpm (1⅛ in. ID) and 144 gpm (5¼ in. ID) models. Present 2¼-in. pump costs $21.95; delivery, 30 days. **Transflo Corp, 7662 Melrose Ave, Los Angeles 46, Calif.**

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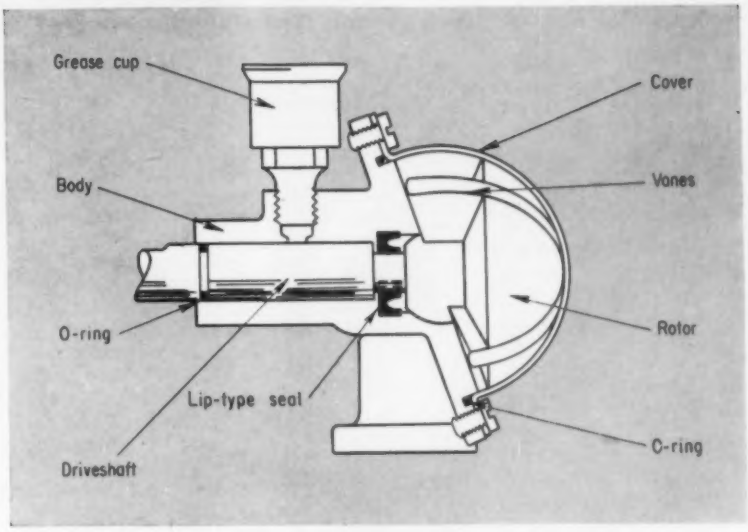

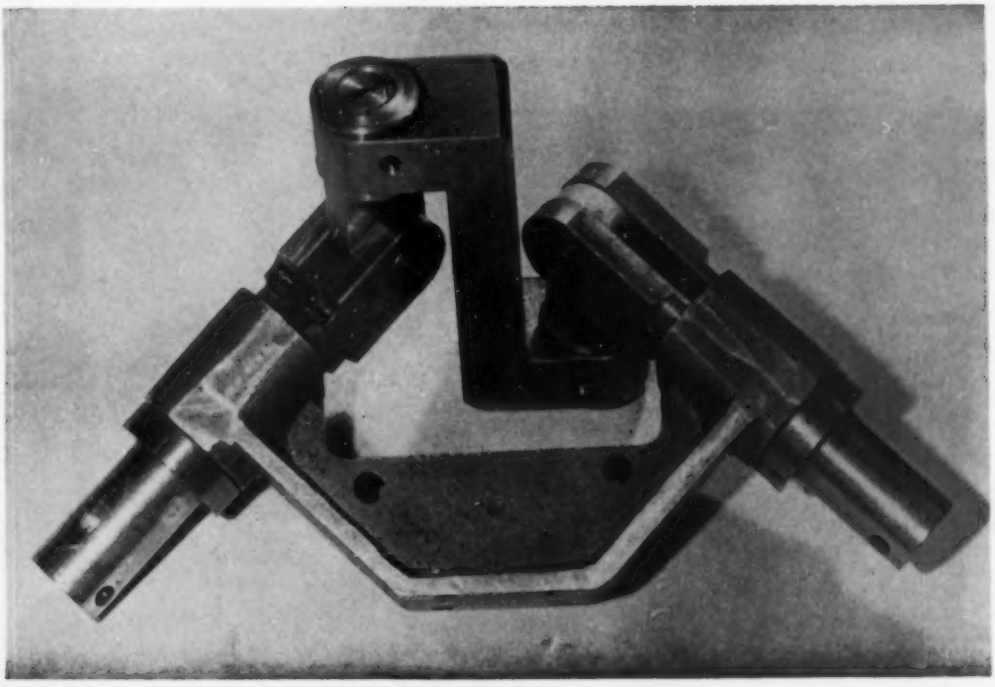

First 90° uniform-motion transmitter . . .

originally designed for marine steering system, is said to provide min backlash and to be limited in torque capacity only by material and size of shaft with which it is used. Has been tested at 1600 rpm, although speed is not a limiting factor. Available for use with shafts of ¼ in. dia and up, transmitter can function as a right angle drive, or by varying shape and angles, can act as a coupling (zero angle) or transmit angles up to 90°. Also, center link can be replaced by gear, sheave or sprocket to drive two output shafts at desired angle. Compares favorably in price with precision bevel gear unit. Delivery, 30 days. **Katydid Mechanisms Inc, 5122 Fort Hamilton Pkwy, Brooklyn, NY.**

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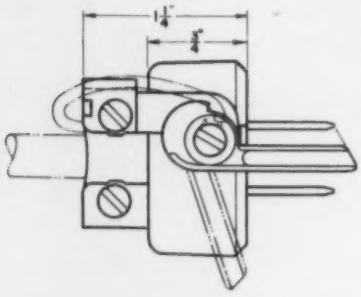
SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .



Swing-blade armored plug . . .

grounds itself when inserted into standard two-hole electrical receptacle. Upon insertion, grounding blade deflects to one side and chisel-scraper makes grounding contact with receptacle faceplate. When used with three-hole receptacle, automatic blade registers with grounding hole. Improper insertion of plug is prevented by polarized, current-carrying contact blade. Power connector is rated 125 v at 15 amp to 250 v at 10 amp. Delivery, 2 to 3 wk. **APM Corp, 252 Hawthorne Ave, Yonkers, NY.**

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Coded infrared radiation . . .

is used as the basis of this photoelectric control system, to permit high sensitivity with minimum interference or saturation by random light. Consists of a projector and a receiver, secured together by quick-detach hinge, but with no necessary electrical interconnection. Receiver circuits are tuned to modulation frequency, virtually eliminating response to signals from sources other than projector. Operates equally well on interruption of direct beam or on reflection from objects. Depending upon general illumination level in area, range of control is up to 400 in. by reflection and 400 ft. by interruption. Relay operating speed is 600 operations per min, with equal on-off times. Relay contacts are rated 10 amp, 115 v; 5 amp, 230 v ac. Requires 115 v, 60 cps power supply. Each of the two units is about 6 x 5 x 7 in. high. Has plug-in mounting. **Cramer Controls Corp, Centerbrook, Conn.**

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High-strength plastic film . . .

is said to have shear strength and tear resistance, even when stitched, that may lead to its replacing more expensive films that must be reinforced with fabric for greater strength. Reported to be unaffected by gasoline or other petrol products, aging, nuclear radiation, ozone, and resistant to abrasion. Can be sealed to itself electronically or by heat. Remains flexible at sub-zero temperatures with satisfactory service at −40 F and lower. Available in 0.008 gage tan and 0.015 gage black film, 54 and 16 in. wide. Both tan and black are priced at $2.50 per lb. Ready for immediate delivery in quantities for testing. Other gages, to 0.045, are available on special order. **B F Goodrich Industrial Products Co, Div of B F Goodrich Co, 500 S Main St, Akron 18.**

Circle 105 on Reader Service Card

Static relay line . . .

for applications from signal programming to static contactors are said to exhibit fast response speed, long life and high reliability under adverse environmental conditions. Sensitive, polar and latching relays operate with input signal level of less than 1 v at less than 15 microamp. High-power static contactors, utilizing silicon-controlled rectifiers, are typically actuated with 10 v, 10 milliamp signal. Turn on instantly, off within half-cycle. Transient overload current capabilities range to 150 amp max. Temperature range is −40 to 212 F, with power factor variation from 0.7 lead to 0.7 lag. Contactor, rated 115 v, 400 cps, 20 amp and SPST control relay, rated 28 v, 20 milliamp were introduced previously. Prices range from $95 for the previously-introduced SPST control relay to $475; 30 day delivery. **Walter Kidde & Co Inc, 9 Brighton Rd, Clifton, NJ.**

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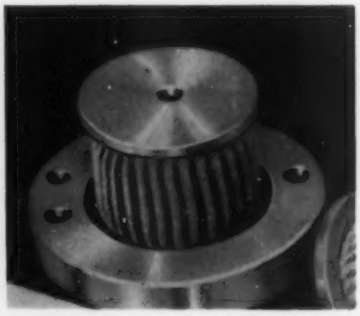

1.18-oz filter unit . . .

with relief valve is rated at 2 microns and at 15 microns absolute. For 0.3 gpm operation under normal conditions; and at 0.8 gpm under intermittent surge. Temperature range is −65 to 275 F. Relief valve cracking pressure is 150 ± 15 psi. Unit is made of stainless steel. Originally designed for use on pump for hydraulic oil, filter can be used with other fluids, including corrosives, and with gases. **Aircraft Porous Media Inc, Glen Cove, NY.**

Circle 107 on Reader Service Card

Synthetic oil . . .

is said to have properties that suit it for hydraulic operations. Medium-viscosity synthetic diester has operating temperature range of −65 to 350 F. Evaporation rate is 5:1. Offers built-in rust protection and anti-foam. Compatible with ordinary lubricants. **Lehigh Chemical Co, Industrial Lubricant Div, Chestertown, Md.**

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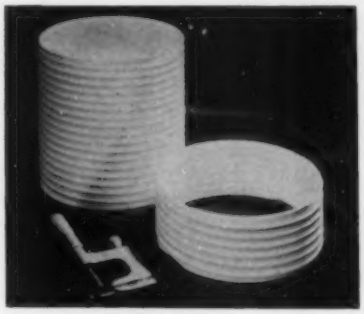

Ceramic forming . . .

firing and grinding techniques permit fabrication of extremely thin-wall, large-diameter cylinders and other similar shapes. Cylinder shown, made of 95% alumina, measures 5.062 in. OD, 4.875 in. ID. Helical groove was machined. **Centralab, Div Globe-Union Inc, 900 E Keefe Ave, Milwaukee 1.**

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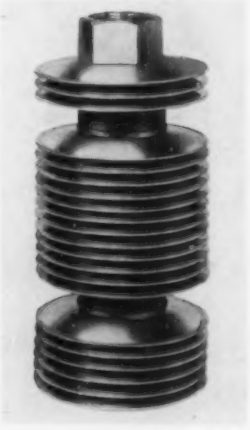

Magnetic sump strainer . . .

to protect hydraulic equipment meets new JIC specifications for magnets in hydraulic systems. Strainer has built-in circular magnets between removable filter disks, at specific intervals. Screens remove non-magnetic matter and the rest of the unit traps magnetic particles. Available in range of standard and special sizes. **Ripley Screen & Strainer Co, Filter Div, 32749 Northwestern Highway, Farmington, Mich.**

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Coating resists corrosion . . .

and is said to dry fast and to have a tough film. Chlorinated rubber is used as a base

CONTINUED ON PAGE 40

CIRCLE 39 ON READER SERVICE CARD→

J. F. HARPER, OF HARPER
BUFFING MACHINE COMPANY, SAYS . . .

"General Electric Motor *Econo-matching** Saved Me Over $1300 Per Machine!"

***GENERAL ELECTRIC ECONO-MATCHING** is the quick and accurate matching of Tri-Clad '55' a-c motors to machines by skilled G-E engineers.

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"G-E ENGINEERS STUDIED OUR APPLICATION," said Mr. Harper, "and advised that we could get maximum efficiency and economy by replacing the drive we had selected with a Tri-Clad '55' 50-hp open drip-proof motor. We did, and realized an immediate savings of over $1300 per unit!"

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†Trademark of Harper Buffing Machine Co.

GENERAL ELECTRIC

RETURN THIS COUPON . . .
for more Econo-matching details, or call your nearby General Electric Apparatus Sales Office for complete information on how G.E. can ECONO-MATCH a motor to meet your specific requirements.

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General Electric Company
Schenectady, New York

Please furnish more information on how you can ECONO-MATCH a motor for my application, which is _____

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COMPANY _____

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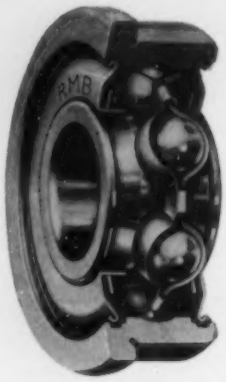

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Write to us for full details on these and the other miniature and instrument ball and roller bearings in the RMB line.

LANDIS & GYR, Inc.

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(1) Capable of assuming overall responsibility for design of automatic, coin operated vending machines to dispense bulk beverages. Must have considerable experience with either or both coffee vending machines and carbonated cold drink vending machines. Specific experience with design of fresh brew coffee vending machines is highly desirable.

(1) Capable of assuming overall responsibility for design of automatic coin operated package vending machines. Must have considerable experience in design of small package vendors. Specific experience with design of candy vending machines is highly desirable.

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Excellent opportunity for Mechanical Engineer with creative ability to work in the design of automatic machinery. Work includes designing converting equipment for a medium-sized paperboard manufacturer and converter located in Michigan. Experience in paperboard products desirable, but not necessary. Salary commensurate with experience and ability. Excellent educational, cultural, and recreational facilities available in the immediate area. All replies held in strict confidence. Please send complete resume of educational background and work experience including present salary to

P-2900 Product Engineering
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140 Federal St., Boston 10, Mass. LIberty 2-6658

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

CONTINUED FROM PAGE 38

vehicle in coating and is combined with alkyd-type resins. Reported to be highly resistant to moisture and constant humidity, salt spray, acids and alkalis. **Industrial Finishes Co Inc, 1119 Land Title Bldg, Broad & Chestnut Sts, Philadelphia 10.**

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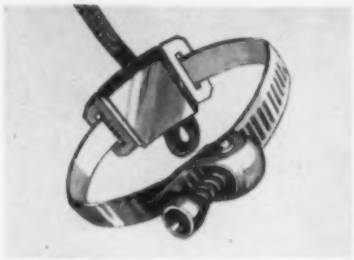

Surface thermometer . . .

is strapped to unit being measured. For constant-duty temperatures of —100 to 500 F and intermittent temperatures of —300 to 575 F, thermometer consists of 100-ohm (at 70 F) CP nickel element completely encapsulated in silicone rubber and stainless steel (0.002 in. thick for flexibility). Moisture-resistant, self-contained, reusable thermometer can also be immersed in fluids or molded into units where inside temperature is to be measured. **Arthur C Ruge Associates Inc, Hudson, NH.**

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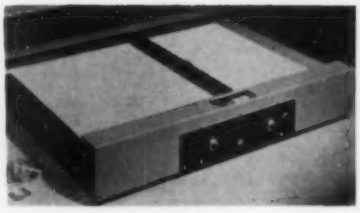

24 x 36-in. plotter . . .

multiplies small mechanical movements up to 100:1 with total error less than 0.15%. Operates from differential transformers. 20 micro in. movements are said to be readily detectable. Uses standard 24 x 36 in. D size paper or 24 in. roll stock graph paper. Dual vacuum hold-down system also permits use of half-size sheets. Servo systems operate from 50 to 60 cps line frequency. Pen speed with standard servo is 2 in. per sec; speeds to 20 in. per sec are available. Domestic price is $3200, FOB Houston. Delivery, 60 days. **Houston Instrument Corp, 1717 Clay Ave, Houston 3.**

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San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

NEW LITERATURE

Automation, Cybernetics and Society

F H GEORGE. Philosophical Library, Inc, 15 E 40th St, New York 16. 5¾ x 8¼, 285 pp. $12.

Here is an over-all picture of those new fields of science that promise so much for the future. Individual chapters discuss cybernetics, communication theory, logic machines, computers, servo systems, feedback, and computers that are programmed to learn. In the final chapters, the author shows how these disciplines are linked together for application to automation and operations research. It is not a text intended for specialists in any field; it is directed at clarifying the aims and importance of these new fields for the scientists, executive, layman. —CJL

A Philosopher Looks At Science

JOHN G KEMENY, Dartmouth College. D Van Nostrand Co. Inc, Princeton, NJ. 6 x 9, 274 pp. $6.50.

Beyond the realm of science lies a host of intriguing philosophical problems which scientists make no effort to solve; these problems are left to the philosophers. This book, written by an exceptionally able philosopher and mathematician (Dr. Kemeny is Professor of Philosophy and Chairman of the Department of Mathematics and Astronomy, Dartmouth College), attempts to give a unified picture of the nature of science by exploring and clarifying fundamental problems.

What are these problems that scientists do not write about—unless, of course, they happen to be acting as philosophers? They include the questions that are pre-supposed by science: language, mathematics, basic assumptions, and probabilities. These topics make up the first part of A Philosopher Looks at Science.

The author then moves on to science itself, under such headings as scientific method, credibility and induction, concepts of science, measurement, and scientific explanations, leading to "What is Science?"

The last six chapters probe some of the intriguing probems that arise out of science: • Do we live in a completely determined universe? • What is life? • What is the nature of our minds? • What is the status of values? • What is the nature of the social sciences?

Heat and Mass Transfer

An International Journal of Heat and Mass Transfer is to be published bimonthly, beginning January 1960. Emphasis will be placed on original research, both analytical and experimental, of interest to both research and engineering personnel. The Journal will carry only papers that have appeared previously elsewhere. An international bibliography of recent papers on heat and mass transfer will appear regularly. Subscriptions are $20 to libraries, government, industry and universities; private individuals, $10. Write to: International Journal of Heat and Mass Transfer, Pergamon Press, Inc, 122 E 55th St, New York 22.

RELAY DEFINITIONS AND TESTING PROCEDURES—Report, 70 pp. Presents suggested definitions and test procedures, discusses test equipment and precautions, outlines work yet to be done and solicits comments and suggestions on work accomplished to date. National Association of Relay Manufacturers, PO Box 6, Stillwater, Okla.

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MILITARY SPECS—Catalog 50, 32 pp. Combines catalog of military electronic components with handbook on US military specifications covering those components. Contains summary charts, dimensional drawings and graphs. Ohmite Mfg Co, 3675 Howar St, Skokie, Ill.

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SEMICONDUCTOR PRODUCT APPLICATION—Technical publication, issue 1. Bi-monthly publication contains technical data and application information on silicon semiconductor devices. Called "Span." Semiconductor Div, Hoffman Electronics Corp, 1001 Arden Dr, El Monte, Calif.

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CUSTOM MOLDING—Catalog 01.000.3, 4 pp. Describes custom molding service, line of molded products and how designers have utilized new plastics. Richardson Co, Melrose Park, Ill.

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New York 36, N.Y.

For Your Information

Batteries get to the point

What's the latest to go on "portable power"? The li'l old pencil sharpener. But it's not so little, and you'd hardly recognize it: It's restyled—no handle, of course; and sports a smart new case, big enough (3 in. high, about 6 in. long) to hold the 3 flashlight batteries which, it's claimed, will supply power for at least 6 months. It has a price tag to match, too: $10.40.

The name: Kent Kordless, available from Hammacher Schlemmer, 145 E. 57 St, New York 22, NY.

Groundskeeping in style

Want a safer, quieter power mower? You'll have one, says David Lilly, president of Toro Mfg Corp. But not completely silent. Why? It just wouldn't be safe. The big problem now is not with the machines themselves but with the people that operate them—ignoring instructions and circumventing safety rules just as do operators of machine tools (*PE*—Oct 12, p 37). Toro's latest effort to circumvent the circumventers is a "dead man" control built into the seat of rider models so the machines won't operate at all when the driver is not aboard.

As to silence, tests show mufflers can eliminate intake and exhaust noise; though, at the present stage of development they'd add too much to mower cost. But there's much more to the noise problem than that. Toro engineers found that when intake and exhaust noise were muffled, other engine noises like "piston slap" became all too apparent. (Thinning down the cylinder may solve that one; but there are others.)

Blade noise is still another problem-to-solve. One suggested solution: Turn the "unpleasant" sound into a "pleasant" one by means of harmonics. Toro tried it. A single "pleasing" note is a lot worse after 20 min or so than the present slams and rattles.

But, though the musical mower is not to be found, the 1960 Toros will offer increased mobility with "flying saucers" mounted on the front (see below), easier engine starting, and new convenience of control.–ARG

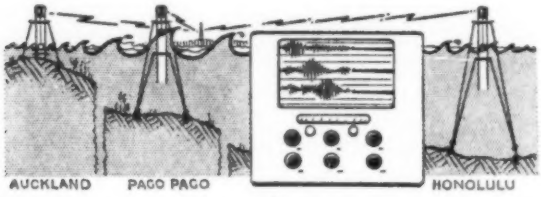
Why Don't They

RESEARCH and DEVELOP . . .

The following problems have been encountered by the Armed Forces:

. . . a compact, accurate, rapid method for determining freezing point of liquid coolants in military equipment during arctic operation. Instruments now in use are cumbersome and must be operated by technical personnel. An instrument is needed that would make the desired measurement as easily as with conventional automotive hydrometer—but with improved accuracy with a variety of different fluids.

. . . an improved material for resistance thermometers. Thermistors give a comparatively large signal for small changes in temperature but are expensive and affected by other environmental changes. A material is needed that gives a large change in resistance for changes in temperature and can be drawn or formed into a filament in a fashion similar to that used in fabricating platinum resistance elements such as those in conventional instruments.



. . . a device to measure height of large water waves (up to 75 feet) as a function of time. Unit must be self-contained, not sensitive to shock, and capable of measurements with an accuracy of one foot, in water ranging from 25 to 2000 feet in depth.

. . . a pressure-sensitive altimeter for measuring altitudes up to 500,000 feet or higher. Must be simple, compact, lightweight and suitable for installation on all present types of aircraft.

If you think you have a solution for any of these problems—or if you wish additional information—get in touch with National Inventors Council, US Department of Commerce, Washington 25, DC.

Have you a problem, based on known scientific principles, which seems to have an answer somewhere within the limits of present technology? To inspire inventors along worthwhile paths, PROJECT ENGINEERING invites you to trade such problems with fellow readers who may have a fresh viewpoint or more time for necessary R & D. We will pay $10 for each one accepted.

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Publisher's Postscript...

NOT INVENTED HERE

Engineers are often accused of shuttered thinking when ideas for new products, or redesigns of familiar ones, are suggested by outsiders. It's another example of the "in's" versus the "out's" and probably characteristic of human nature. Human nature is even worse when an idea is expressed in a foreign language. "Anybody who speaks that gobbledegook can hardly be expected to have a worthwhile idea."

Until recently it made no difference. A designer was rarely faced with a competitive product designed and manufactured in an economy different from his own. Today "not designed here" could be stamped on an amazingly large percentage of the goods we buy.

As striking as these changes in our own marketplace are, think how much greater are the changes in world markets. Europe, North Africa, South America, and even Canada and Mexico find manufacturers in their own and in neighboring countries can make products as up-to-date in every way–and at a lower price than those made in the US.

We need that world market. We need it so badly that many American manufacturers are establishing plants and engineering divisions on foreign soil. Labor and materials cost are lower as are the costs per cubic foot of production facility. These foreign made-by-American-manufacturer products can compete with foreign products on their own grounds. They've even started to bounce back into our own markets, as we are already observing in foreign-made automobiles made by American companies in England and France.

There's a saying among economists that money goes where it will earn the most return. A recent report by the McGraw-Hill department of economics called, "Survey of Foreign Operations by US Industrial Companies 1959-1960" shows that American industry plans to spend more than $2.1 billion on new facilities abroad this year–5% more than in 1958. The reason is simple: US manufacturing companies expect sales of their foreign subsidiaries to rise further than exports from their US plants. Where would you make next year's capital investment?

If you would like a copy of this report write "foreign" on the Reader Service card and we will send you one without charge.

–SJA

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A rugged, dependable new shaft seal for a broad variety of applications

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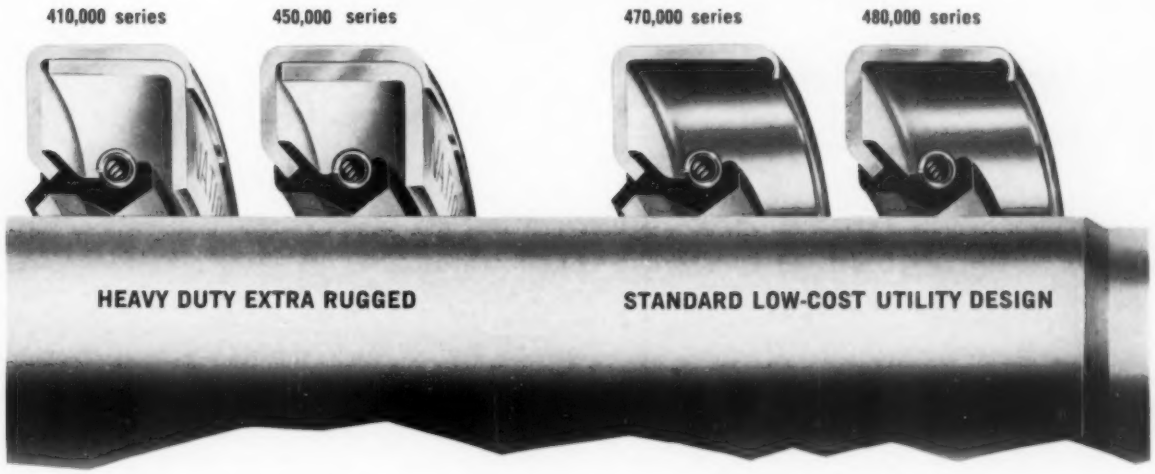

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NATIONAL SEAL

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6071

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A fine racing car must be *precision-designed* and *precision-built* . . . as must the motors for your appliance or equipment applications. At Emerson-Electric, you get the benefits of more than 65 years of experience in solving motor-drive problems . . . plus unique production facilities that produce *in volume* the precision motor specifically designed for *you*.

Remember . . .

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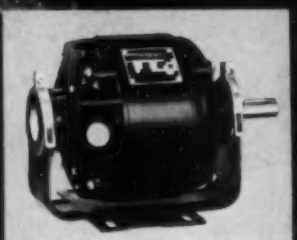

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